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DEFENSE SCRAP YARD HANDBOOK

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FOREWORD

This handbook is issued under the authority of DoD Directive 4160.21, "DoD Personal Property Utilization and Disposal Program," 5 December 1980. Its purpose is to outline practical, cost-effective methods for the recovery and recycling of scrap by providing technical guidance on scrap identification and segregation, scrap yard operations and merchandising of scrap.

DSAH 4160.1, TM 755-200, NAVSUP PUB 5523, AFM 68-3, MCO P4010.2A, "Defense Scrap Yard Handbook," June 1966, is hereby cancelled.

The provisions of the handbook apply to the Office of the Secretary of Defense (OSD), the Military Departments, the Organization of the Joint Chiefs of Staff, the Unified and Specified Commands, the Defense Agencies, and activities administratively supported by OSD (hereafter called "DoD Components").

The handbook is effective immediately and is mandatory for use by all DoD Components. Heads of DoD Components may issue supplementary instructions only when necessary to provide for unique requirements within their respective components.

Send recommended changes to this handbook through DoD Component channels to:

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Defense Logistics Agency
ATTN: DLA-SMP
Cameron Station
Alexandria, Virginia 22304-6100

DoD Components may obtain copies of this handbook through their publication channels. Other federal agencies may obtain copies from HQ Defense Logistics Agency, ATTN: DLA-XPD, Cameron Station, Alexandria, Virginia 22304-6100.

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Acknowledgment is made to the following sources of information used in compiling this handbook:

Institute of Scrap Iron and Steel, Inc., Handbook, published by the Institute of Scrap Iron and Steel, Inc., 1627 K Street, N.W., Washington, DC 20006

Metal Statistics, 1980 edition, published by Fairchild Publications, a division of Capital Cities Media, Inc., 7 East 12th Street, New York, NY 10003

Metallic Materials Specifications Handbook, third edition, by Robert B. Ross, published by E. & F. N. Spon Ltd. in association with Methuen, Inc., 733 Third Avenue, New York, NY 10017

Mines Above Ground, published by the Institute of Scrap Iron and Steel, Inc., 1627 K. Street, N.W., Washington, DC 20006

Recycling In Your Community, published by the National Association of Recycling Industries, Inc., 330 Madison Avenue, New York, NY 10017

Recycling Resources: Priorities for the 1980's, published by the National Association of Recycling Industries, Inc., 330 Madison Avenue, New York, NY 10017

Recycled Metals Indentification and Testing Handbook, published by the National Association of Recycling Industries, Inc., 330 Madison Avenue, New York, NY 10017

Standard Classification for Nonferrous Scrap Metals, Circular NF-82, published by the National Association of Recycling Industries, Inc., 330 Madison Avenue, New York, NY 10017

Paper Stock Standards and Practices, Circular PS-83, published by the National Association of Recycling Industries, Inc., 330 Madison Avenue, New York, NY 10017

Concise Guide to Plastics, Second edition, published by Reinhald Publishing Corp., 430 Park Avenue, New York, NY 10022

Health and Safety Guide for Scrap Processors, DHEW Publication No. (NIOSI-1) 76-125, 4676 Columbia Parkway, Cincinnati, OH 45226

TABLE OF CONTENTS

TABLE OF CONTENTS, continued

APPENDICES

DL1. DEFINITIONS-METAL

DL1.1. DEFINITIONS RELATING TO METALS AND METALWORKING

These definitions apply to the scrap industry and to mill products in any form as supplied by the mills. Materials in process in the mills are sometimes referred to by terms other than those applied to the materials as supplies.

DL1.1.1. Age Hardening. A process of increasing the hardness and strength by the precipitation of particles of a phase from a supersaturated solid-solution alloy. The hardening cycle usually consists of heating or annealing at a temperature sufficiently high to maintain solid solution, rapid cooling or quenching to retain the supersaturated solid solution, and subsequent heating at a temperature lower than the solution anneal to effect the precipitation.

DL1.1.2. Alloy. A substance having metallic properties and composed of two or more elements, at least one of which is a metal.

DL1.1.3. Angle. A shape consisting of two straight legs meeting in a right angle (usually, but not necessarily) of equal length and with a sharp or slightly rounded corner and with or without fillets.

DL1.1.4. Annealing. A process involving heating and cooling designed to effect:

DL1.1.4.1. Softening of a cold-worked structure by recrystallization or grain growth or both;

DL1.1.4.2. Softening of an age-hardened alloy by causing a nearly complete precipitation of the second phase in relatively coarse form;

DL1.1.4.3. Softening of certain age-hardenable alloys by dissolving the second phase and cooling rapidly enough to obtain a supersaturated solution; and

DL1.1.4.4. Relief of residual stress.

DL1.1.5. Anode

DL1.1.5.1. In corrosion processes, usually the metal that has the greater tendency to dissolve.

DL1.1.5.2. In electroplating, the positive electrode used in a plating bath.

DL1.1.6. As-Hot-Rolled. A condition of a metal mill product resulting from hot rolling, soft, not cleaned nor drawn or rolled to size.

DL1.1.7. As-Is-State. Represents that the quality of the lot is based on the analysis findings in the "As is" state without predetermination or accountability for the burning loss (B/L).

DL1.1.8. Billet. A solid cylindrical casting used for hot extrusion into rod, bar, tube, or shape or for hot piercing into tube.

DL1.1.9. Blades. Refer to the turbine rotor blades or bucket blades associated with the jet engine or the steam engine, and which is the motive part on which the gas or pressure steam impinges and transmits the power to create motion.

DL1.1.10. Blanking. The process of cutting metal blanks by a die and punch set in a press, or by sawing or shearing.

DL1.1.11. Blister. A void in, or raised spot on the surface of a metal, caused by expansion of entrapped gas in the metal.

DL1.1.12. Brass. Any copper-base alloy with zinc as the principal alloying element, with or without small quantities of some other elements.

DL1.1.13. Brasses. Copper alloys:

DL1.1.13.1. Admiralty. A tin brass containing nominally 70 percent copper; 1 percent tin and 29 percent zinc, orginally developed by the British Admiralty and generally available in tube, flat products, and wire. Its principal use is in heat exchanger and condenser tubes. An inhibitor may be added to increase the resistance to dezincification.

DL1.1.13.2. Admiralty, Inhibited (antimonal, arsenical or phosphorized). Admiralty modified by the addition of .02-10 percent of antimony, arsenic or phosphorus to inhibit dezincification.

DL1.1.13.3. Aluminum Brass. A brass containing nominally 76 percent copper, 2 percent aluminum and 22 percent zinc with an inhibitor, available in tube form. Its principal use is in heat exchanger and condenser tubes.

DL1.1.13.4. Architectural Bronze. A brass containing nominally 57 percent copper, 3 percent lead, and 40 percent zinc, generally available in extruded or drawn

shapes and rod; used for architect trim and for some mechanical applications. The alloy is not technically a bronze, but because of long usage the term "Architectural Bronze" has gained widespread acceptance.

DL1.1.13.5. Cartridge Brass, 70 Percent. A brass containing nominally 70 percent copper and 30 percent zinc and generally available in pin products, rod, wire and tube.

DL1.1.13.6. Clock Brass. A term sometimes used to designate high-leaded brass suitable for specific uses. It is recommended that this alloy be identified by the term "high-leaded brass" properly qualified for the specific use.

DL1.1.13.7. Collet Brass. A term sometimes used, but not recommended. See High-Leaded Brass and Free-Cutting Brass.

DL1.1.13.8. Commercial Bronze, 90 Percent. A brass containing nominally 90 percent copper and 10 percent zinc, generally available in flat products, wire, rod and tube. The alloy is not technically a bronze, but cause of long usage the term "commercial bronze" has gained widespread acceptance.

DL1.1.13.9. Core Brass. See Radiator Core Brass.

DL1.1.13.10. Deep Drawing Brass. A term sometimes used, but not recommended, to denote nonleaded brasses of nominal copper content ranging from 65 to 70 percent. See Yellow Brass, or Cartridge Brass, 70 percent.

DL1.1.13.11. Engraver's Brass. A term sometimes used, but not recommended. See High-Leaded Brass.

DL1.1.13.12. Etching Brass. A term used to indicate quality of material rather than chemical composition. The term signifies a flat product having unusual freeedom from surface defects; very flat and usually of quarter-hard or half-hard temper.

DL1.1.13.13. Extra-high-leaded Brass. A brass containing nominally 63 percent copper, 2.5 percent lead, and 34.5 percent zinc, generally available in flat rolled products, and used for engraving and other operations requiring considerable cutting.

DL1.1.13.14. Eyelet Brass. A term sometimes used, but not recommended. See Cartridge Brass, 70 percent.

DL1.1.13.15. Forging Brass. A brass containing nominally 59 percent copper, 2 percent lead, and 39 percent zinc, generally available in rod, bar, tube and tapes and

recommended for fabrication by hot-forging and hot-pressing. It has excellent machinability, approaching that of free-cutting brass.

DL1.1.13.16. Free-Cutting Brass. A brass containing nominally 61.5 percent copper, 3 percent lead and 35.5 percent zinc, generally available in rod and drawn bar and in extruded shapes. It is the most commonly used alloy for automatic screw machine work, or for other applications where material of maximum machinability is desired.

DL1.1.13.17. Free-Cutting Muntz-Metal. A brass containing nominally 60 percent copper, 1 percent lead, and 39 percent zinc. Generally available as tube. It is used for automatic-screw machine-products where maximum machinability is not necessary.

DL1.1.13.18. Gilding, 95 percent. A brass containing nominally 95 percent copper and 5 percent zinc. This alloy is generally available in flat products, rod and wire.

DL1.1.13.19. High-Leaded Brass. A brass containing nominally 65 percent copper, 2 percent lead, and 33 percent zinc, generally available in flat products and rod. It is used where easy stamping and machining are desired, as for instance, in clock and notch backs and gears and for engraving.

DL1.1.13.20. High-Leaded Brass (tube). A brass containing nominally 66 percent copper, 1.6 percent lead, and 32.4 percent zinc. It is recommended for automatic screw machine operations.

DL1.1.13.21. Jewelry Bronze-87.5 percent. A brass containing nominally 87.5 percent copper and 12.5 percent zinc having a rich golden color. It is used for costume jewelry, slide fasteners and as a base for gold-filled articles. Variations may contain small amounts of tin.

DL1.1.13.22. Leaded Commercial Bronze. A brass containing nominally 89 percent copper, 1.75 percent lead, and 9.25 percent zinc, generally available in rod, shapes, and bar, and used extensively for hardware. The alloy is not technically a bronze, but because of long usage the term "leaded commercial bronze" has gained widespread acceptance. Hardware bronze is a term formerly used to designate any one of a broad range of similar alloys; this term is not recommended.

DL1.1.13.23. Leaded Muntz Metal. A brass containing nominally 60 percent copper, 0.6 percent lead, and 39.4 percent zinc generally used for condenser tube plates.

DL1.1.13.24. Leaded Naval Brass. A brass containing nominally 60 percent copper, 0.75 percent tin, 1.75 percent lead, and 37.5 percent zinc, generally available in rod, shapes, and bar. This alloy has the equivalent strength and corrosion resistance of naval brass, plus considerably improved machinability.

DL1.1.13.25. Leaded Red Brass. A brass containing nominally 85 percent copper, 2 percent lead and 13 percent zinc, generally available in rod and drawn bar. Hardware bronze is a term formerly used to designate any one of a broad range of similar alloys; this term is not recommended.

DL1.1.13.26. Low Brass, 80 percent. A brass containing nominally 80 percent copper and 20 percent zinc and generally available in flat products, rod and wire.

DL1.1.13.27. Low-Leaded Brass. A brass containing nominally 65 percent copper, 0.5 percent lead, and 34.5 percent zinc, and generally available in flat products. It is widely used for stamping and light drawing operations.

DL1.1.13.28. Manganese Bronze. A brass containing nominally 58.5 percent copper, 1 percent tin, 1.4 percent iron, 0.1 percent manganese, and 39 percent zinc, generally available in rod, flat products shapes, and wire. This alloy is appreciably harder and stronger than naval brass and is, therefore, preferred to the latter for many structural uses. It is also an excellent brazing alloy.

DL1.1.13.29. Muntz Metal. A brass containing nominally 60 percent copper and 40 percent zinc and generally available in flat products, rod, wire, and tube.

DL1.1.13.30. Naval Brass. A brass containing nominally 60 percent copper, 0.75 percent tin and 39.25 percent zinc, generally available in rod, bar, wire, shapes, tube and to some extent in flat products. It is used in marine construction where a strong, hard material is required.

DL1.1.13.31. Plater's Brass. A term sometimes used, but not recommended, to indicate specific alloys used as anodes for brass plating. These vary in composition from 30 to 90 percent copper, 10 to 20 percent zinc, and sometimes 1 to 2 percent tin.

DL1.1.13.32. Primer Brass. A term sometimes used, but not recommended, to denote a specific alloy used for making primer caps and tubes. Primer caps are made from cartridge brass, 70 percent; commercial bronze, 90 percent; or gilding, 90 percent. Primer tubes are made from lowleaded or highleaded brass.

DL1.1.13.33. Radiator Core Brass. A term used to indicate strip brass of suitable characteristics for forming radiator cores. It is sometimes used, but not recommended, to designate a specific alloy.

DL1.1.13.34. Red Brass, 85 percent. A brass containing nominally 85 percent copper, 5 percent tin, 5 percent lead, and 5 percent zinc.

DL1.1.13.35. Reflector Brass. A term used to indicate strip brass with suitable characteristics for forming into reflectors. It is sometimes used, but not recommended, to designate a specific alloy, usually yellow brass or cartridge brass, 70 percent, having a small grain size that will take a moderately deep draw and a very high polish.

DL1.1.13.36. Yellow Brass. A brass containing nominally 65 percent copper and 35 percent zinc and generally available in flat products, wire and rod.

DL1.1.13.37. 7-30 Brass. A term sometimes used, but not recommended, for cartridge brass, 70 percent copper, and 30 percent zinc.

DL1.1.14. Braze Welding. A method of welding whereby a groove, fillet, plug or slot weld is made using a nonferrous metal having a melting point below that of the base metals, but above 800°F. The filler metal is not distributed in the joint by capillary attraction. (The term "bronze welding," formerly used, is a misnomer for this process.)

DL1.1.15. Brazing. A joining process wherein coalescence is produced by heating to suitable temperatures above 800°F, and by using a nonferrous filler metal having a melting point below that of the base metals. The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction. See also Soldering.

DL1.1.16. Bronze. Originally a term for copper-base alloys having tin as the only or principal alloying elements. In modern usage the term "bronze" is seldom used alone, and the terms "phosphor bronze" or "tin bronze" are considered preferable for indicating copper-tin alloys. In fact, the term "bronze," together with a suitable modifying adjective, has in recent years been extended to apply to any of a great variety of copper-base alloy systems, and such usage has gained widespread acceptance. The more important alloys designated as bronzes are as follows

DL1.1.16.1. Aluminum Bronzes. Copper-base alloys with aluminum as the principal alloying element, normally in the range of 3 to 11 percent with or without the additions of other elements.

DL1.1.16.2. Architectural Bronze. See Brasses.

DL1.1.16.3. Commercial Bronze, 90 percent. See Brasses.

DL1.1.16.4. Leaded Commercial Bronze. See Brasses.

DL1.1.16.5. Manganese Bronze. See Brasses.

DL1.1.16.6. Phosphor Bronzes. Copper-base alloys with tin as the principal alloying element deoxidized with phosphorus. Various types are available in flat products, rod, tube, wire and shapes, the most common ones containing nominally 1.25 percent to 10 percent tin.

DL1.1.16.7. Silicon Bronzes. Any copper-base alloy with silicon as the main alloying element, with or without additions of such elements as zinc, manganese, aluminum, iron or nickel. The more commonly used silicon bronzes are:

DL1.1.16.7.1. High-silicon bronze, nominally containing 96 percent copper and 3 percent silicon; and

DL1.1.16.7.2 Low-silicon bronze, nominally containing 97.7 percent copper and 1.5 percent silicon.

DL1.1.16.8. Tin Bronze. See Phosphor Bronzes.

DL1.1.17. Burning Loss (B/L). Refers to the percentage of water, oil, other extraneous moisture and combustible matter which, by ignition or evaporation method, is determined as a separate part of the analysis procedure.

DL1.1.18. Bus Bar and Bus Conductor. Rigid, high-conductivity copper electrical conductor of tubular or solid section.

DL1.1.19. Button Analysis. The meltdown of a sample, usually in the "as is" state, and the casting of the molten metal into a button or bar-shape mold, whereby the metallic content is determined by the difference between the input and output weight. The button is then assayed for the required elements and, by calculation, the analysis may be deduced and reported either for the "as is" state or on the metallic yield basis.

DL1.1.20. Casting. By trade history, "castings" are considered a distinct physical form of solids. It is accordingly described here to convey the understanding that this form of scrap does not originate from rolled, forged, or extruded source.

DL1.1.21. Channel. A shape having two straight flanges or legs of equal length, extended at right angles from same side of the edges of a web or base, the legs and base having sharp or slightly rounded without fillets.

DL1.1.22. Circle. A completely round, commercially flat, solid blank made from a flat rolled product.

DL1.1.23. Clean. Meaning a state or condition of cleanliness; namely, free of paint, insignificant in moisture content, or deleterious external matter.

DL1.1.24. Clipping. The operation of trimming or cutting off uneven edges of forgings or articles drawn or formed from sheet or strip.

DL1.1.25. Cold Working. The process of changing the form or cross section of a piece of metal at a temperature below the softening or recrystallization point, but commonly at or about room temperature. It includes rolling, drawing, pressing, and stretching.

DL1.1.26. Condenser Tube. See Tube, Heat Exchanger Tube.

DL1.1.27. Condenser Tube Plate. Plate manufactured to special thickness tolerances and furnished in various contours as tube sheets or head plates in condensers and heat exchangers.

DL1.1.28. Copper. Commercially pure copper-metal for which the specified minimum copper content is not less than 99.88 percent, silver being counted as copper. Modified copper-metal for which the specified minimum copper content is less than 99.88 percent and more than 99.3 percent, silver being counted as copper.

DL1.1.29. Copper Types:

DL1.1.29.1. Arsenical, Tough-pitch Copper (ATP). A modified tough-pitch copper containing substantial amounts of arsenic regardless of origin or treatment.

DL1.1.29.2. Cathode Copper. A commercially pure copper electrolytically refined in cathode form.

DL1.1.29.3. Coalesced Copper. A commercially pure oxygen-free copper formed in a protective atmosphere at elevated temperature, but below its melting point by application of mechanical pressure to particles of electrolytic cathode copper.

DL1.1.29.4. Deoxidized Arsenical Copper (DPA). A modified deoxidized copper containing the designated element (arsenic) in amounts as agreed upon between the supplier and the consumer mainly for the purpose of increasing corrosion resistance.

DL1.1.29.5. Deoxidized Copper Low Residual Phosphorus (DLP) High Conductivity. A commercially pure copper that has heen deoxidized with phosphorus in such a manner as to leave a very low residual phosphorus content. It is not readily susceptible to hydrogen embrittlement, and has a conductivity approximately equivalent to that of tough-pitch copper.

DL1.1.29.6. Deoxidized Copper, Silver Bearing (DPS). A commercially pure deoxidized copper containing the designated element (silver) in amounts as agreed upon between the supplier and the consumer.

DL1.1.29.7. Deoxidized Copper Tellurium Bearing (DPTE). A modified deoxidized copper containing the designated element (tellurium) in amounts as agreed upon between the supplier and the consumer to improve machinability The conductivity is somewhat lower than that of electrolytic tough-pitch copper.

DL1.1.29.8. Electrolytic Tough-Pitch Copper (ETP). A commercially pure copper of any origin that has heen refined by electrolytic disposition, then melted, oxidized and brought to tough-pitch or controlled low-oxygen content, and finally cast into cakes, billets, wire bars, etc., suitable for hot or cold working, or both.

DL1.1.29.9. Fire-Refined Copper (FRHC and FRTP). A commercially pure copper of any origin or type that is finished by furnace refining without, at any stage, having been electrolytically refined.

DL1.1.29.10. Lake Copper. A commercially pure copper from the Lake Superior district, generally fire refined and containing variable, but controlled, amounts of silver and arsenic. Such copper of low-arsenic content is called Prime Lake Copper, while that of higher arsenic content is called Arsenical Lake Copper -- also low, medium and high Arsenical Lake Copper. Also see Arsenical Copper and Silver-Bearing Copper.

DL1.1.29.11. Oxygen-Free Copper (OF). A commercially pure copper that has heen produced in such a manner as to contain no oxide or residual deoxidants. It has very high resistance to hydrogen embrittlment and has equal or better conductivity than tough-pitch copper.

DL1.1.29.12. Oxygen-Free Silver-Bearing Copper (OF). A commercially pure high-conductivity copper containing the designated element (silver) in amounts as agreed upon between the supplier and the consumer for the purpose of raising the softening temperature.

DL1.1.29.13. Phoshorus Deoxidized Copper, High-Residual Phosphorus (DHP) (Low Conductivity). A commercially pure copper that has heen deoxidized with phosphorus, leaving a relatively high-residual phosphorus content. It is not susceptible to hydrgen embrittlement, but is of relatively low conductivity due to the amount of phosphorus present.

DL1.1.29.14. Silver-Bearing (Argentiferous) Copper. Any copper containing substantial amounts of silver, regardless of origin or treatment.

DL1.1.29.15. Silver-Bearing Arsenical Tough-Pitch Copper (SATP). A modified tough-pitch copper containing the designated elements (silver and arsenic) in amounts as agreed upon between the supplier and consumer mainly for the purpose of increasing corrosion resistance and raising the softening temperature.

DL1.1.29.16. Silver-Bearing Tough-Pitch Copper (STP). A commercially pure high-conductivity tough-pitch copper containing the designated element (silver) in amounts agreed upon between the supplier and the consumer for the purpose of raising the softening temperature.

DL1.1.29.17. Tough-Pitch Copper. Commercially pure or modified copper, either electrolytically or fire refined, containing a controlled amount of oxygen for the purpose of obtaining a level set in the casting.

DL1.1.30. Copper Anode. See Anode.

DL1.1.31. Copper-Base Alloy. Metal for which the specified minimum copper content is less than 99.3 percent and not less than 40 percent and having no other element specified in excess of the copper content.

DL1.1.32. Copper-Beryllium Alloy. A heat-treatable copper alloy containing 1.50 - 2.25 percent beryllium and sometimes small amounts of cobalt, nickel and chromium. It is capable of being formed readily when in the soft condition and heat treated to hardnesses approaching those of steel.

DL1.1.33. Corrosion. The deterioration or failure of metals and alloys by chemical or electrochemical processes.

DL1.1.33.1. Cavitation. The damage caused to a material by moving liquid and associated with the formation and collapse of cavities in the liquid at the solid-liquid interface.

DL1.1.33.2. Dealuminification. A phenomenon somewhat similar to dezincification involving loss of aluminum.

DL1.1.33.3. Denickelification. A common phenomenon somewhat similar to dezincification involving loss of nickel.

DL1.1.33.4. Dezincification. Corrosion of an alloy containing zinc (usually brass) involving loss of zinc.

DL1.1.33.5. Erosion. The abrasion of metal or other material by liquid or gas, usually accelerated by presence of solid particles of matter in suspension, and sometimes by corrosion.

DL1.1.33.6. Impingement Attack. A type of localized corrosion caused by the striking of a liquid containing entrained gasses on a metal surface.

DL1.1.33.7. Stress Corrosion. Spontaneous failure of metals by cracking under combined action of corrosion and stress, residual or applied.

DL1.1.34. Corrosion Fatigue. The deterioration of properties resulting from repeated stressing of a metal in a corrosive medium. The rate of deterioration is greater than that resulting from either repeated stressing or corrosion alone.

DL1.1.35. Cupro-Nickel (Copper Nickel). A copper-base alloy composed of copper and nickel with nickel content usually being 10, 20, or 30 percent and with small additions of elements such as iron and manganese.

DL1.1.36. Deoxidized. A term applied to any metal or alloy to indicate that it has been treated to remove oxygen. It is specifically applied to copper and refers to removal of oxygen by means of phosphorus or other strong deoxidizing agents.

DL1.1.37. Diced Turning. Synonymous to "short shoveling," describes the treatment of machine shop turnings reduced through the attrition of a hammer or cog mill to a state of under 2 inches in length.

DL1.1.38. Drawing

DL1.1.38.1. The process of pulling flat products, rod, wire, tube, shapes, etc., through a die. This effects a reduction in size or change in shape of the cross section and hardens the metal.

DL1.1.38.2. The process of making articles in a press from blanks cut from flat products in which the gage is reduced by pushing the metal between a punch and die to develop the sidewalls of the part.

DL1.1.39. Dryweight. Represents the payable weight of the material content as determined by analysis and after allowance or deduction of the B/L.

DL1.1.40. Ductility. The property of a metal that permits permanent deformation before fracture by stress in tension.

DL1.1.41. Extruded Bar, Extruded Rod, Extruted Shape, Extruded Tube, Extruded Wire. Stock brought to final dimensions by extrusion.

DL1.1.42. Extrusion, Hot. The process of shaping metal into a chosen continuous form by forcing it from a closed container through a die of appropriate shape.

DL1.1.43. Extrisopm Pipe. A defect that occurs during extrusion and is located internally at the back end of the extruded piece. This defect is removed by cropping off the back end.

DL1.1.44. Eyelet-Brass. See Brasses.

DL1.1.45. Fatigue. The tendency for a metal to break under conditions of repeated cyclic stressing considerably below the ultimate tensile strength.

DL1.1.46. Ferrule. Metal ring or collar used in installation of boiler flues, condenser tubes and similar applications.

DL1.1.47. Filler Metal. A metal or alloy that is melted down in a welding or brazing operation to supply metal for the joint.

DL1.1.48. Finish. The condition of the surfaces of the products, produced by normal or special mill procedures. Several types of finishes can be produced as follows:

DL1.1.48.1. Acid Dipped Dry Rolled Finish. The finish obtained by cold dry rolling on polished rolls of material, previously bichromate dipped or bright dipped, giving a burnished appearance and retaining the color obtained by dipping.

DL1.1.48.2. Bright Annealed Finish. The finish obtained by annealing under conditions of controlled atmosphere to prevent oxidation and to retain the original luster of the product. See also Annealing.

DL1.1.48.3. Bright-Dipped Finnish. A bright finish having the true color of the metal obtained by immersion in an aqueous solution of sulfuric acid and nitric acid, using the following formula: Sulfuric acid, 2 gallons; nitric acid, 1 gallon; water, 1 to 2 quarts; hydrochloric acid, 1/2 fluid ounce.

DL1.1.48.4. Bright Rolled Finish. See Dry Rolled Finish.

DL1.1.48.5. Brush Brass Finish. A frosted finish obtained on brass by brushing with a Tampico (Bristol brush) wheel treated with brush rouge and rotating at high speed.

DL1.1.48.6. Buffed Surface Finish. The finish obtained by buffing with rouge or similar abrasive, resulting in a high gloss or polish. This may be applied in one operation or two, commonly known as cutting and coloring operations.

DL1.1.48.7. Clean Annealed Finish. A finish characterized by a light iridescent film generally obtained on copper-base alloys that have been annealed in a controlled atmosphere.

DL1.1.48.8. Cold Rolled Finish. The finish obtained by cold rolling of plain pickled strip with a lubricant; causing a relatively smooth appearance. In the case of sheet or strip, cold rolling may be done without any lubricant, the finish then being similar to that described under Dry Rolled Finish.

DL1.1.48.9. Drawn Finish. The finish obtained on tube, wire, and drawn rod, bar and strip by drawing through a die resulting in a relatively smooth and bright appearance.

DL1.1.48.10. Dry Rolled Finish (Bright Rolled Finish)

DL1.1.48.10.1. The finish obtained by cold rolling on polished rolls without the use of any coolant or metal lubricant on material previously plain pickled, bichromate or bright dipped;

DL1.1.48.10.2. The finish obtained by the rolling or tumbling of brass articles in a barrel with either dry sawdust, leather or scrap cork.

DL1.1.48.11. Extruded Finish. The finish obtained on tube, wire, and rod, bar and strip by hot extrusion through a die, resulting in a slightly oxidized and dull appearance.

DL1.1.48.12. Hot Rolled Finish. The finish obtained by rolling metal while hot resulting in a dark oxidized and relatively rough surface.

DL1.1.49. Flat Product. A product with rectangular or square solid section and relatively great length in proportion to thickness.

DL1.1.49.1. Drawn Flat Product. Flat product brought to final dimensions by drawing through a die, and burnished in flat straight lengths, on spools, or in rolls. The corners or edges may be square or of other contours.

DL1.1.49.2. Rolled Flat Product. Flat product brought to final thickness by rolling, and furnished in flat straight lengths, on spools, or in rolls. Longitudinal edges may be those resulting from final rolling to thickness or the product may he brought to final width by shearing, slitting, sawing, machining or rolling. The corners or edges may be square or of other contours.

DL1.1.50. Flattening. The mill operation performed on rolled flat products to reduce departure from flatness, such as curl and dish.

DL1.1.51. Flux

DL1.1.51.1. In melting, a substance added to the melt to promote removal of foreign materials, and protect the surface.

DL1.1.51.2. In brazing or welding, a substance introduced to remove oxide and impurities.

DL1.1.52. Foil. A term often applied to a thin flat rolled section usually .005 inch or less in thickness.

DL1.1.53. Foundry Spills, Splatters and Skulls. Refers to the characterstic foundry salvage resulting from the surface oxidation of the melting operation that is skimmed off. It may result from the spilling of metal in the casting operation, the metal skullings that cling to the walls of the pouring ladle or furnace walls, the runoff

of the accumulated furnace bottoms, or it may consist of such metal of porous oxidized condition unsuited for further foundry reuse. Usually foundry skulls, spills, and spatters may range from a high of 95 percent metallic content and dependent on the cleanliness or freedom of adhesive scale, oxide, dirt, and brick matter termed "silicous matter," may dip to a low of 50 percent of metallic content. Accordingly, it is vital that the metallic yield should be noted for any parcel of this nature.

DL1.1.54. Fourdriner Wire. Wire used in making the Fourdrinier screens used in the manufacture of paper.

DL1.1.55. Free Machining. The quality of an alloy that enables it to be cut in automatic machines at relatively high speeds, yielding a short brittle chip.

DL1.1.56. Gage

DL1.1.56.1. Term sometimes used to designate thickness of flat products, wall thickness of tube or diameter of wire.

DL1.1.56.2. The instrument used to measure thickness or diameter.

DL1.1.57. Gage Number. A number in a specific series used to designate a dimension. There are several series of such gage numbers, of which the most familiar are the American Wire Gage or Brown & Sharpe and Birmingham or Stubs.

DL1.1.58. Gassing

DL1.1.58.1. A phenomemon in metal caused by absorption of gas while molten and partial evolution as the metal cools, resulting in voids.

DL1.1.58.2. A condition in oxygen-bearing copper which has been heated to elevated temperatures in a highly reducing atmosphere.

DL1.1.59. Grain. A solid polyhedral (or many-sided) crystal consisting of groups of atoms bound together in a regular geometric pattern. In mill practice, grains are usually studied only as they appear in one plane.

DL1.1.60. Grindings. The occurrence of grindings derived from the processing termed "metal dressing." The friction of a high-speed grinding wheel results in a conglomerate Byproduct consisting of somewhat oxidized metal particles and grinding wheel matter. The particles usually are under cinch in screen size and tend to curl and intertwine to form a condition termed "dumpiness." The term "free flowing condition" merely signifies that the grindings can be worked by hand shoveling or pitchfork. The

term "frozen condition" implies that the grindings have been exposed to water inclusion and have become congealed or surface crusted. Such condition does not bear on the quality of the material and, in effect, indicates that the grindings may require hammer mill treatment to reduce to free shoveling state.

DL1.1.61. Half Hard Temper. See Temper.

DL1.1.62. Hammer Forging. A forging process in which the piece is deformed by repeated blows.

DL1.1.63. Hand Straightening. See Straightening.

DL1.1.64. Hard Temper. See Temper.

DL1.1.65. Hardness. The resistance of metal to plastic deformation by indentation. The most common method of measurement is Rockwell. Other methods are Brinell, Scleroscope, Tukon, and Vickers.

DL1.1.66. Hardness Number. The number used to designate the hardness of metal. The number is related to the scale of values of a particular hardness test, as Rockwell B 80 or Brinell 150.

DL1.1.67. Heat Treatment. A combination of heating and cooling operations applied to a metal or alloy in the solid state to produce changes in physical and mechanical properties. See also Age Hardening and Annealing.

DL1.1.68. Ingot Maker. A nonferrous manufacturer who heats secondary material (scrap) in a furnace, melting into ingots of a prescribed specification.

DL1.1.69. Inhibitors. Elements added in small amounts to alloys to increase the resistance of the alloys to corrosion.

DL1.1.70. Lake Copper. See Copper Types.

DL1.1.71. Lap. A surface defect appearing as a seam, caused by folding over hot metal, tins, or sharp corners and then rolling or forging, but not welding, them into the surface.

DL1.1.72. Leaded Brasses. Copper-base alloys, generally of copper and zinc to which lead has been added to improve machinability. See Brasses.

DL1.1.73. Lengths. The terms employed to designate lengths are as follows:

DL1.1.73.1. Mill Lengths. Certain uniform lengths subject to established tolerances with short lengths included according to established schedule.

DL1.1.73.2. Multiple Lengths. Lengths of integral multiples of a base length, with suitable allowance for cutting, if and as specified. Several different multiples of the base length may be included in any lot, at the mills' discretion.

DL1.1.73.3. Random Lengths. Run-of-mill lengths without any indicated preferred length.

DL1.1.73.4. Specific Lengths. Indicated uniform lengths subject to established length tolerances; for example: 12'-0", 9'-7" or 0'-41/2" is a specific length.

DL1.1.73.5. Specific Lengths with Ends. Indicated uniform lengths of 6 feet or over, subject to established length tolerances and with ends included according to established length schedules; for example: 10'-0" with ends or 6'-5" with ends.

DL1.1.73.6. Standard Lengths. Standard lengths are lengths that have been recommended in a simplified practice recommendation or established as a Commercial Standard by the National Bureau of Standards, Department of Commerce, as standard lengths for certain products. Products such as copper and red brass pipe, copper water tube, copper threadless pipe (TP), copper refrigeration, and general service tube and copper drainage tube (DWV) are furnished in standard lengths.

DL1.1.73.7. Stock Lengths. Normally certain uniform lengths subject to established tolerances (including standard lengths) actually carried in mill and warehouse stocks. The nominal length actually carried will vary considerably with the product, alloy, size,and mill source and warehouse location.

DL1.1.74. Machine Shop Turning. To denote a condition of turnings, consisting mainly of long streamers intertwined and interlocked in an unwieldy clump-like mass.

DL1.1.75. Magnet. This form is too well known to require descriptive amplification: Magnets may range from the miniature (under 2 ounces) to the electronic magnetrons that may weigh upward to 25 pounds. All magnet scrap should be free of insulation or outer shielding covers.
NOTE: Magnets, in the magnico category, are highly friable. The examination of the resulting fracture offers some clue to the recognition of the "alnico" V (five) grade in that the fracture of this particular allow will reveal a large crystalline appearance. The other alnicos show a distinctive smaller lattice or grain due to the lower cobalt content. Tape shielding contains high sulpher and antimony, and should be removed before melting to prevent contamination.

DL1.1.76. Malleability. The property of a metal that permits deformation by rolling, heading, hammering or extension by pressure without fracturing.

DL1.1.77. Manganese Bronze. See Brasses.

DL1.1.78. Millings. As distinct from turnings, consist of a finer particle of metal. Usually under three-eighths inch in width or length of thickness, and which is generated through the finishing machining to fine tolerances. Especially prevalent to the close final machining and drilling of bucket blades.

DL1.1.79. Naval Brass. See Brasses.

DL1.1.80. Naval Brass Welding Rod. See Welding Rod.

DL1.1.81. Nickel Silver. Copper-base alloys containing nickel and zinc, formerly sometimes called German silver. These alloys are primarily used for their distinctive colors, which range from yellow to silvery white.

DL1.1.81.1. Nickel Silver, 55-18. An alloy nominally containing 55 percent copper, 18 percent nickel, and 27 percent zinc.

DL1.1.81.2. Nickel Silver, 65-10. An alloy nominally containing 65 percent copper, 10 percent nickel, and 25 percent zinc.

DL1.1.81.3. Nickel Silver, 65-12. An alloy nominally containing 65 percent copper,12 percent nickel, and 23 percent zinc.

DL1.1.81.4. Nickel Silver, 65-15. An alloy nominally containing 65 percent copper,15 percent nickel, and 20 percent zinc.

DL1.1.81.5. Nickel Silver, 65-18. An alloy nominally containing 65 percent copper,18 percent nickel, and 17 percent zinc.

DL1.1.82. Non-Refractory. A term applied to those copper-base alloys which, because of a lack of hardness or abrasiveness, present relatively little difficulty in maintaining standard dimensional tolerances.

DL1.1.83. Oxygen-Free Silver Bearing Copper (OFS). See Copper Types.

DL1.1.84. Pellets. Synonymous with "Shot," "granulars," a pebble-like shape of irregular size and shape, usually under 2 inches, produced by controlled casting of the stream of hot metal into a tank of water.

DL1.1.85. Pickling. The process of removing surface oxide and scale from copper alloys with a mill pickle solution consisting of approximately 12 to percent sulfuric acid in water by volume.

DL1.1.86. Piercing

DL1.1.86.1. The process, also known as "Mannesmann Process," by which seamless tubes are made from solid billets. A heated billet is rapidly rotated and driven ahead by drive rolls, the action of which is to form an opening in its center. The forward movement imparted by the rolls carries the shell over a freely rotating mandrel, which shapes the inner surface of the tube.

DL1.1.86.2. Punching holes in sheet or strip, or walls of shells.

DL1.1.87. Pin Test. See Tests, Expansion (Pin).

DL1.1.88. Pipe. Seamless tube conforming to the particular dimensions, commercially known as standard pipe sizes.

DL1.1.89. Prepared. Signifies that the physical dimensions of the scrap are in conformance to trade-practice such as "prepared" into bales, or drums, crucible shape, open-hearth size, etc.

DL1.1.90. Radiator Core Brass. See Brasses.

DL1.1.91. Random Lengths. See Lengths.

DL1.1.92. Ready-to-Finish. A general mill term applied to size and condition of a product prior to the final drawing or rolling operation.

DL1.1.93. Refinery. A nonferrous manufacturer who heats secondary material (scrap) in a furnace for the base metal content, melting the metal into intermediate shapes.

DL1.1.94. Recrystallization. The change in grain structure that occurs when the metal is annealed, during which the deformed grains, strain-hardened by working, become new unstrained grains.

DL1.1.95. Rolling. The process of passing metal between rolls under pressure to reduce its cross section.

DL1.1.95.1. Cold Rolling. This process is carried out below the softening point of the metal and, with copper alloys, usually at room temperature.

DL1.1.95.2 Hot Rolling. This process is carried out above the softening temperature and, with copper alloys, usually at temperatures from about 1,200°F. to1,700°F., 650°C. to 927°C.

DL1.1.96. Rotating Band Blank. An unfinished tubular blank for making rotating bands for use on artillery projectiles. Sometimes termed driving band blank or projectile band blank.

DL1.1.97. Sawed Bar. A bar brought to finished width by sawing.

DL1.1.98. Sawed Edges. The edges resulting when a product is brought to final width and length by sawing. The edges are parallel and at right angles to the rolled surface.

DL1.1.99. Scale

DL1.1.99.1. A heavy oxide coating on copper and copper-base alloys resulting from exposure to high temperatures in an oxidizing atmosphere.

DL1.1.99.2. A product resulting from the corrosion of metals.

DL1.1.100 Scrap Broker. A scrap broker is a buyer and seller of scrap for his own account, but does not physically handle the material.

DL1.1.101. Scrap Broker-Dealer. A broker-dealer performs primarily the functions of a broker, but also maintains a physical inventory of scrap and processes material for his own account.

DL1.1.102. Scrap Dealer. A scrap dealer is an operator of a scrap yard taking physical possession of the material for the purpose of sorting and preparing scrap to meet mill specifications and requirements.

DL1.1.103. Short Shoveling. When applied to scrap solids or turnings, means material of such dimensional size that can he manually handled by a shovel.

DL1.1.104. Slab. A casting in the form of a bar used for rolling into strip.

DL1.1.105. Sludge. A mud-like material originating from the chemical industry or the ceramic industry, in the form of a residue scrap byproduct, or as a spent catalyst, or in the form of other chemical substances. Sludge, or such type of scrap should be offered in the following indicated manner:

DL1.1.105.1. Moisture content.

DL1.1.105.2. Assay to be established on dry content.

DL1.1.105.3. When feasible, the metallic yield for the dry content should be supplied.

DL1.1.106. Smelter. A nonferrous manufacturer that produces a shape wherein the prime ingredient is ore.

DL1.1.106.1. Custom Smelter. Melts secondary material (scrap) into refined copper.

DL1.1.106.2. Secondary Smelter. Melts scrap material into specification ingots.

DL1.1.107. Soldering. Joining metals by fusion of alloys that have relatively low-melting points--most commonly, lead-base on tin-base alloys, which are the soft solders. Hard solders are alloys that have silver, copper or nickel bases. Use of these alloys with melting points higher than 800°F., 427°C. is properly called "brazing."

DL1.1.108. Solids. Trade term "solids" covers almost every conceivable shape manufactured for commercial or military application. It applies to the trade term titled "generated scrap" in solid form. Also, see "Specifics."

DL1.1.109. Spaghetti. Pertinent to solids, conjures an optical or mental picture of a jumbled mass of voluminous condition, unprepared scrap, irregular and numerous varied large shapes and sizes. Particularly, pertinent to long streamers of sheet cuttings, slittings, wire, and cable whereby one end of the piece is at one part of the pile and the other end is intertwined.

DL1.1.110. Specifics. The following enumerated descriptions are indicative and exemplify the proper meaning of the term "solids."

DL1.1.110.1. Blades. Shall refer to the turbine rotor blades or bucket blades associated with the jet engine or the steam engine, and that is the motive part on which the gas or pressure stream impinges and transmits the power to create motion. Blades are produced from forgings or are casted to critical dimensions. Bucket blades may range in weight from an ounce to several pounds.

DL1.1.110.2. Clippings. Refers to cuttings, stampings, trimmings, resulting from the fabrication and working of new sheet metal.
NOTE: "New," by trade custom refers to plant generated scrap.

DL1.1.110.3. Jet Solids. Occurring mainly from sheet stock fabricated parts utilized in the hot section of the jet engine and found mostly in the form of shrouds, outer casings, braking flaps, tail cones, after burners, nozzles, and other engine parts.
NOTE: The weight saving requirement of the jet engine necessitates using thin gage metal, (8 to 22 gage) which often is stiffened by bracing sections to avoid metal warping under extreme heat conditions. Often the braces are made of other nickel containing heat-resisting alloy. These braces or other attachments are usually of minor ratio and since the metal content is of a non-harmful nature, a small tolerance of such braces or attachments may be included in the overall lot.

DL1.1.110.4. Old Sheet. Salvage in the form of sheet occurring from obsolete, rejected or Service-retired scrap. May include material with brazed seams, also some slight attachment of non-harmful metal attachment.

DL1.1.110.5. Solids, Other. The following are usually present in the scrap delineation and need no elaborate further description, namely: rod and bar ends, pipe ends, plate cuttings, bolts and nuts, billet ends, forgings, flashing, etc.

DL1.1.111. Spelter. Mill term for cast zinc. Spelter usually is produced in the form of flat slabs for re-melting.

DL1.1.112. Spill. A defect that originates during casting and after rolling or drawing appears as a discontinuity either on the surface or as a faint streak which, on distortion, becomes opened or blistered.

DL1.1.113. Spot Plate. A non-reactive nonporous glass or mineral plate with one or more shallow depressions in which to perform chemical reagent identification testing of metal filings, chips, or borings.

DL1.1.114. Steel Mill:

DL1.1.114.1. Integrated Steel Mill. A manufacturer of steel who owns or controls all of the ores, materials, and physical facilities for manufacturing steel from raw material to the finished steel, with the exception of purchased scrap.

DL1.1.114.2. Non-Integrated Steel Mill. Lacks ownership or control of certain phases of manufacturing steel and usually purchases from other firms the necessary ingredients as phases of operation rerquired to complete the cycle of the steel manufacturing process.

DL1.1.115. Straightening. Any process applied to tube, rod, bar, or wire that eliminates any general or local curvature resulting from mill processing.

DL1.1.115.1. Hand Straightening. The process of straightening by bending or twisting by hand with the aid of adjustable supports and suitable hand tools, usually applied to shapes and to large diameter tubes.

DL1.1.115.2. Inclined Roll Straightening. (Such as Medart). The process of straightening round rod or tube by passing the product through a machine with rolls having special contours and whose axis are at a slight angle so as to give the product a helical forward motion with repeated flexing in all planes through the axis.

DL1.1.115.3. Roll Straightening. The process of straightening tube, rod and bar by passing lengthwise through a machine with suitable rolls so as to repeatedly flex the product in two planes at right angles.

DL1.1.116. Straightening and Flattening. Any process applied to flat-rolled products to eliminate any general or local curvature, either with respect to flatness or edgewise curvature.

DL1.1.116.1. Roll Flattening. The process of flattening a product by machine with a number of small diameter cylindrical rolls so positioned as to repeatedly flex the product and thus remove certain irregularities in shape. Roll flattening practically eliminates longitudinal curl, burr, and dish. It reduces edge-wise curvature of narrow strip. This operation reduces buckles, but is relatively ineffective in eliminating wavy edges, ripples and twist. Roll flattening is ordinarily applied to a flat-rolled product within the approximate size range .010 inch to 1/8 inch thick and in widths to about 48-inch, and is particularly effective on annealed tempers, but is prgressively less effective wih increase in degree of rolled temper.

DL1.1.116.2. Stretcher Straightening (Patent Leveling). Applicable to flat straight lengths. A process that simultaneously flattens and straightens a product by longitudinally stretching it beyond its elastic limit. This process removes buckles, ripples, wavy edges, twist and edgewise curvature, is partially effective in removing longitudinal curl, but is ineffective in removal of crown, dish and burr. It is commonly applied to flat-rolled products within the approximate size range of 3-inch to 48-inch wide and 0.012 inch to 0.050 inch thick. It is particularly effective on all annealed tempers and on rolled tempers up to half hard.

DL1.1.117. Stretcher Straightening. See Straightening and Flattening.

DL1.1.118. Stresses:

DL1.1.118.1. Applied Stress . Stresses that are set up and exist in a body during application of an external load.

DL1.1.118.2. Residual Stress. Stresses that remain within a body as the result of plastic deformation, casting, or rapid temperature change.

DL1.1.119. Stress Corrosion. See Corrosion.

DL1.1.120. Strip. A flat product, other than flat wire, up to and including thickness and generally furnished as follows:

DL1.1.120.1. With slit, sheared or slit and edge rolled in widths up to 20-inch inclusive.

DL1.1.120.2. With finished drawn or rolled edges in widths over 1 1/4-inch to 12-inch inclusive.

DL1.1.121. Temper. The condition produced in a metal by mechanical or thermal treatment and having characteristic structure and mechanical properties.

DL1.1.122. Tensile Strength. The value obtained by dividing the maximum load observed during tensile straining by the specimen cross-sectional area before straining. Also called "ultimate strength." It is usually expressed in pounds per square inch.

DL1.1.122.1. Bend. A test sometimes made to indicate ductility or bending a suitable specimen about a predetermined radius through a predetermined angle.

DL1.1.122.2. Brinell Hardness. A test made to determine hardness on relatively thick sections of metal by pressing a steel ball of specified diameter into a test specimen under a specified load. This test is seldom used on copper and copper-base alloys.

DL1.1.122.3. Creep. A test to determine the extension of metallic materials due to the combined effects of temperature, tensile stress and time. Inherently, it is a long-term test, not suitable for specification purposes.

DL1.1.122.4. Cup. A test to indicate the ductility of sheet or strip wherein a cup is drawn from the metal until it fractures. Several modifications of the original Erichsen method are now in use.

DL1.1.122.5. Endurance. A test to determine the endurance limit of a metal's resistance to fatigue by subjecting a specimen to repeated alternating or pulsating stresses.

DL1.1.122.6. Expansion (pin). A test used to determine the capacity of the tube for expansion, to reveal surface defects of the tube for expansion and to reveal surface defects by pushing a tapered pin into the open end of a specimen.

DL1.1.122.7. Flattening. A test made on annealed tube to indicate ductility and freedom from mechanical defects.

DL1.1.122.8. Hydrostatic. A test to prove soundness and resistance to leakage of tube and pipe under internal water pressure.

DL1.1.122.9. Impact. A test made to determine the resistance of metals to failure by sudden shock load.

DL1.1.122.10. Mercurous Nitrate. An accelerated test to indicate the resistance of copper-base alloy products to season cracking.

DL1.1.122.11. Pneumatic. A test used to prove resistance to leakage of tube or pipe by the application of internal air pressure to the product while submerged in water.

DL1.1.122.12. Rockwell Hardness. A test to measure hardness by determining the depth of penetration into a specimen of a penetrator under predetermined conditions of test.

DL1.1.122.13. Tension. A test to determine one or more of the following: tensile strength, yield strength, elongation, and contraction of area.

DL1.1.122.14. Torsion. A test to determine the strength in torsion by measuring the torque required to twist a specimen of given length through a predetermined angle.

DL1.1.123. Tolerance. The amount by which any characteristic, such as dimensional, chemical, physical, or mechanical properties, may vary from that specified.

DL1.1.124. Tube. A hollow product of round or any other cross section having a continuous periphery.

DL1.1.124.1. Copper Service Tube. Bandable copper water tube for underground water services. See Copper Water Tube.

DL1.1.124.2. Copper Water Tube. Seamless copper tube conforming to the particular dimensions commercially known as copper water tube and designated as types "K", "L", and "M."

DL1.1.124.3. Heat Exchanger Tube. Tube manufactured to special requirements as to dimensional tolerances, finish, and temper for use in condensers and other heat exchangers.

DL1.1.124.4. Lock Seam Tube. Tube made from sheet or strip, with a longitudinal, mechanically locked seam.

DL1.1.124.5. Oil Burner Tube. Small diameter seamless copper tube of soft temper in coils intended for use in oil burner installations.

DL1.1.124.6. Open Seam Tube. A shape, other than extruded shape, of generally tubular form of nominally uniform wall thickness, but having a longitudinal unjoined seam or gap of width not greater than 25 percent of the outside diameter or greatest overall dimension.

DL1.1.124.7. Pipe, Seamless. Tube conforming to the particular dimensions commercially known as standard pipe sizes (SPS) and designated as regular and extra strong.

DL1.1.124.8. Reeded Outside, Plain Inside Tube. Tube having reeded outside periphery and plain inside periphery.

DL1.1.124.9. Reeded Tube. Tube of nominally uniform wall thickness having regular longitudinal convex corrugations, either with rounded or sharp cusps between corrugations.

DL1.1.124.10. Seamless Tube. Tube produced with a continuous periphery at all stages of the operation, in contrast to "brazed," "welded," "open seams," and "lock seam" tube.

DL1.1.124.11. Welded Tube. Tube made from sheet or strip, with a longitudinal welded joint.

DL1.1.125. Turnings. Likewise trade described as "borings" and "shavings." Results from machining operation and processing of bars, rods, castings, billets, or the machine dressing or finishing of any metal product that results in the occurrence of the usual sliverlike or curlicue shapes. This is generic to the term "turnings." The term "machine shop turnings" indicates that the scrap is voluminous and in bulky condition.

DL1.1.126. Welding. Process of producing localized coalescence of metal by heating to suitable temperatures, with or without the application of pressure, and with or without the use of filler metal. The filler metal either has a melting point approximately the same as the base metal, or has a melting point below that of the base metals, but above 800°F. Common welding processes are:

DL1.1.126.1. Carbon arc welding;

DL1.1.126.2. Metal arc welding;

DL1.1.126.3. Oxyacetylene welding;

DL1.1.126.4. Resistance welding; and

DL1.1.126.5. Shielded arc welding.

DL1.1.127. Welding Rod. Filler metal, in wire or rod form, used in gas welding and brazing processes, and those arc-welding processes wherein the electrode does not furnish the filler metal. Some commonly used welding rods are:

DL1.1.127.1. Aluminum Bronze. A copper-base alloy having aluminum as the major alloying element with or without a small amount of iron.

DL1.1.127.2. Copper. Deoxidized copper containing minor additions of other elements.

DL1.1.127.3. Cupro-Nickel, 30 percent. Copper-base-alloy -- having nickel as the major alloying element (about 30 percent) with minor additions of other elements.

DL1.1.127.4. Low Fuming. Manganese Bronze type welding rod to which a small amount of silicon has been added to reduce the evolution of zinc oxide fumes in welding or brazing.

DL1.1.127.5. Manganese Bronze Welding Rod. A copper-base alloy in which manganese is present in small amount. Usually also contains small quantities of iron and tin. A typical analysis would show about 57 percent copper, 0.7 percent tin, 0.7 percent iron, 0.10 percent manganese, and the remainder zinc.

DL1.1.127.6. Naval Brass. An alloy of approximately 60 percent copper, 0.7 percent tin, and the remainder zinc.

DL1.1.127.7. Phosphor Bronze. A copper-tin containing residual phosphorus.

DL1.1.127.8. Silicon Bronze. A copper-base alloy having silicon as the major alloying element up to 4 percent with or without lesser amounts of any of several elements such as zinc, tin, manganese, and iron.

DL2.1. DEFINITIONS RELATING TO PLASTICS

There are numerous terms that are peculiar to the plastics industry. Following are definitions of some of the most common terms used in this Handbook (see C5.5.) or that will be found in researching plastics data through most sources:

DL2.1.1. Ablative Plastics. This description applies to a material that absorbs heat (while part of it is being consumed by heat) through a decomposition process known as pyrolysis, which takes place in the near surface layer exposed to heat.

DL2.1.2. Acetal Resins. The molecular structure of the polymer is that of a linear acetal, consisting of unbranched polyoxymethylene chains.

DL2.1.3. Acrylic Ester. An ester of acrylic acid, or of a structural derivative of acrylic acid, e.g., methyl methacrylate.

DL2.1.4. Acrylic Resin. A synthetic resin prepared from acrylic acid or from a derivative of acrylic acid.

DL2.1.5. Acrylonitrile. A monomer with the structure (CH_2:CHCH). It is most useful in copolymers. Its copolymer with butadiene is nitrile rubber, and several copolymers with styrene exist that are tougher than polystyrene. It is also used as a synthetic fiber and as a chemical intermediate.

DL2.1.6. Acrylonitrile-Butadiene-Styrene (abbreviated ABS). Acrylonitrile and styrene liquids and butadiene gas are polymerized together in a variety of ratios to produce the family of ABS resins.

DL2.1.7. Aliphatic Hydrocarbons. Saturated hydrocarbons having an open chain structure. Familiar examples: gasoline and propane.

DL2.1.8. Alkyd Resin. Polyester resins made with some fatty acid as a modifier.

DL2.1.9. Alloy. Composite material made up by blending polymers or copolymers with other polymers or elastomers under selected conditions, e.g., styreneacrylonitrile copolymer resins blended with butadiene-acrylonitrile rubbers.

DL2.1.10. Allyl Resin. A synthetic resin formed by the polymerization of chemical compounds containing the group CH-$CHCH_2$-. The principal commercial allyl resin is a casting material that yields allyl carbonate polymer.

DL2.1.11. Alpha-Cellulose. A very pure cellulose prepared by special chemical treatment.

DL2.1.12. Aromatic Hydrocarbons. Hydrocarbons derived from or characterized by presence of unsaturated resonant ring structures.

DL2.1.13. Biodegradables. Those plastics which, because of their chemical structure, are susceptible to being assimilated by microorganisms such as fungi and bacteria through enzyme action. This mechanism requires heat, oxygen and moisture.

DL2.1.14. Blown Tubing. A thermoplastic film that is produced by extruding a tube, applying a slight internal pressure to the tube to expand it while still molten, and subsequent cooling to set the tube. The tube is then flattened through guides and wound up flat on rolls. The size of blown tubing is determined by the flat width in inches as wound rather than by the diameter as in the case of rigid types of tubing.

DL2.1.15. Bushing (Extrusion). The outer ring of any type of a circular tubing or pipe die that forms the outer surface of the tube or pipe.

DL2.1.16. Caprolactam. A cyclic amidetype compound, containing 6 carbon atoms. When the ring is opened, caprolactam is polymerizable into a nylon resin known as type-6 nylon or polycaprolactam.

DL2.1.17. Casein. A protein material precipitated from skimmed milk by the action of either rennet or dilute acid. Rennet casein finds its main application in the manufacture of plastics. Acid casein is a raw material used in a number of industries including the manufacture of adhesives.

DL2.1.18. Cast

DL2.1.18.1. To form a "plastic" object by pouring a fluid monomer-polymer solution into an open mold where it finishes poIymenzing.

DL2.1.18.2. Forming plastic film and sheet by pouring the liquid resin onto a moving belt or by precipitation in a chemical bath.

DL2.1.19. Catalyst. A substance that markedly speeds up the cure of a compound when added in minor quantity as compared to the amounts of primary reactants.

DL2.1.20. Cellular Plastics. See Foamed Plastics.

DL2.1.21. Celluloid. A thermoplastic material made by the intimate blending of cellulose nitrate with camphor. Alcohol is normally employed as a volatible solvent to assist plasticization, and is subsequently removed.

DL2.1.22. Cellulose. A natural high polymeric carbohydrate found in most plants; the main constituent of dried woods, jute, flax, hemp, ramie, etc. Cotton is almost pure cellulose.

DL2.1.23. Cellulose Acetate. An acetic acid ester of cellulose. It is obtained by the action, under rigidly controlled conditions, of acetic acid and acetic andride on purified cellulose usually obtained from cotton linters. All three available hydroxyl groups in each glucose unit of the cellulose can be acetylated, but in the material normally used for plastics it is usual to acetylate fully and then to lower the acetyl value (expressed as acetic acid) to 52-56 percent by partial hydrolysis. When compounded with suitable plasticizers it gives a tough therm plastic material.

DL2.1.24. Cellulose Acetate Butyrate. An ester of cellulose made by the action of a mixture of acetic and butyric acids and their anhydrides on purified cellulose. It is used in the manufacture of plastics that are similar in general properties to cellulose acetate, but are tougher and have better moisture and dimensional stability.

DL2.1.25. Cellulose Ester. A derivative of cellulose in which the free hydroxyl groups attached to the cellulose chain have been replaced wholly or in part by acidic groups; e.g., nitrate, acetate, or stearate groups. Esterification is effected by the use of a mixture of an acid with its anhydride in the presence of a catalyst, such as sulfuric acid. Mixed esters of cellulose; e.g., cellulose acetate butyrate, are prepared by the use of mixed acids and mixed anhydrides. Esters and mixed esters, a wide range of which is known, differ in their compatability with plasticizers, in molding properties, and in physical characteristics. These esters and mixed esters are used in the manufacture of thermoplastic molding compositions.

DL2.1.26. Cellulose Nitrate (Nitrocellulose). A nitric acid ester of cellulose manufactured by the action of a mixture of sulfuric acid and nitric acid on cellulose, such as purified cotton linters. The type of cellulose nitrate used for celluloid manufacture usually contains 10.8-11.1 percent of nitrogen. The latter figure is the nitrogen content of the dinitrate.

DL2.1.27. Cellulose Propionate. An ester of cellulose made by the action of propionic acid and its anhydride on purified cellulose. It is used as the basis of a thermoplastic molding material.

DL2.1.28. Centrifuge Casting. A method of forming thermoplastic resins in which the granular resin is placed in a rotatable container, heated to a molten condition by the transfer of heat through the walls of the container, and rotated such that the centrifical force induced will force the molten resin to conform to the configuration of the interior surrfce of the container. Used to fabricate large diameter pipes and similar cylindrical items.

DL2.1.29. Chlorinated Polyether. The polymer is obtained from pentaerythritol by preparing a chlorinated oxetane and polymerizing it to a polyether by means of opening the ring structure.

DL2.1.30. Condensation. A chemical reaction in which two or more molecules combine with the separation of water or some other simple substance. If a polymer is formed, the condensation process is called polycondensation. See also Polymerization.

DL2.1.31. Condensation Resin. A resin formed by polycondensation; e.g., the alkyd, phenolaldehyde, and urea formaldehyde resins.

DL2.132. Copolymer. See Polymer.

DL2.1.33. Decorative Sheet. A laminated plastic sheet used for decorative purposes in which the color and/or surface pattern is an integral part of the sheet.

DL2.1.34. Degradable. Plastics that will environmentally decompose to a powder or liquid form through biodegradation, solubility, and photodegradation mechanisms.

DL2.1.35. Dielectric. Insulating material. In radio frequency preheating, dielectric may refer specifically to the material that is being heated.

DL2.1.36. Dimensional Stability. Ability of a plastic part to retain the precise shape in which it was molded, fabricated, or cast.

DL2.1.37. Elastomer. A material, which at room temperature, stretches under low stress to at least twice its length and snaps back to the original length upon release of stress. See also Rubber.

DL2.1.38. Epoxy Resins. Based in ethylene oxide, its derivatives or homologs, epoxy resins form straight-chain thermoplastics and thermosetting resins; e.g., by the condensation of bisphenol and epichlorohydrin.

DL2.1.39. Ester. The reaction product of an alcohol and an acid.

DL2.1.40. Expanded Plastics. See Foamed Plastics.

DL2.1.41. Fiber. This term usually refers to relatively short lengths of very small cross-sections of various materials. Fibers can be made by chopping filaments (converting). Staple fibers may be 1/2 to a few inches in length and usually 1 to 5 denier.

DL2.1.42. Filament. A variety of fiber characterized by extreme length, which permits its use in yarn with little or no twist and usually without the spinning operation required for fibers.

DL2.1.43. Film. An optional term for sheeting having a nominal thickness not greater than 0.010 inch.

DL2.1.44. Flake. Used to denote the dry, unplasticized base of celluloisic plastics

DL2.1.45. Flame-Retarded Resin. A resin that is compounded with certain chemicals to reduce or eliminate its tendency to burn. For polyethylene and similar resins, chemicals such as antimony trioxide and chlorinated paraffins are useful.

DL2.1.46. Flexibilizer. An additive that makes a resin or rubber more flexible; i.e., less stiff. Also see plasticizer.

DL2.1.47. Foamed Plastics. Resins in sponge form. The sponge may be flexible or rigid, the cells closed or interconnected, the density anything from that of the solid parent resin down to, in some cases, 2 pounds per cubic foot. Compressive strength of rigid foams is fair, making them useful as materials for sandwich structures. Both types are good heat barriers.

DL2.1.48. Furan Resins. Dark colored, thermosetting resins available primarily as liquids ranging from low viscosity polymers to thick, heavy syrups.

DL2.1.49. Granular Structure. Non-uniform appearance of finished plastic material due to retention of, or incomplete fusion of, particles of composition, either within the mass or on the surface.

DL2.1.50. High-Pressure Laminates. Laminates molded and cured at pressures not lower than 1000 p.s.i. and more commonly in the range of 1200 to 2000 p.s.i.

DL2.1.51. Honeycomb. Manufactured product consisting of sheet metal or a resin impregnated sheet material (paper, fibrous glass, etc.) that has been formed into hexagonal shaped cells. Used as core material for sandwich constructions.

DL2.1.52. Hydrogenation. Chemical process whereby hydrogen is introduced into a compound.

DL2.1.53. Hydrolysis. Chemical decomposition of a substance involving the addition of water.

DL2.1.54. Hygroscopic. Tending to absorb moisture.

DL2.1.55. Impact Resistance. Relative susceptibility of plastics to fracture by shock; e.g., as indicated by the energy expended by a standard pendulum type impact machine in breaking a standard specimen in one blow.

DL2.1.56. Inhibitor. A substance that slows down chemical reaction. Inhibitors are sometimes used in certain types of monomers and resins to prolong storage life.

DL2.1.57. Insulation. A coating of a dielectric or essentially non-conducting material whose purpose it is to prevent the tranition of electricity.

DL2.1.58. Ion Exchange Resins. Small granular or bead-like particles containing acidic or basic groups, which will trade ions with salts in solutions. Generally used for softening and purifiying water.

DL2.1.59. Isocyanate Resins. Most applications for this resin are based on its combination with polyestors (e.g., polyesters, polyethers, etc.). During this reaction, the reactants are joined through the formation of the urethane linkage--and hence this field of technology is generally known as urethane chemistry.

DL2.1.60. Lacquer. Solution of natural or synthetic resins, etc., in readily evaporating solvents, which is used as a protective coating.

DL2.1.62. Laminated Plastics (Synthetic Resin-Bonded Laminate, Laminate). A platics material consisting of superimposed layers of a synthetic resin impregnated or coated filler that have been bonded together, usually by means of heat and presure, to form a single piece.

DL2.1.62. Marcromolecule. The large ("giant") molecules that make up the high polymers.

DL2.1.63. Melamine Formaldehyde Resin. Classified as a synthetic resin derived from the reaction of melamine (2,4,6 triamino 1,3,5, triazine) with formaldehyde or its polymers.

DL2.1.64. Melt Index. The amount, in grains, of a thermo-plastic resin that can be forced through a 0.0825 inch orifice when subjected to 2160 grams force in 10 minutes at 190°C.

DL2.1.65. Metalizing. Applying a thin coating of metal to a non-metallic surface. May be done by chemical deposition or by exposing the surface to vaporized metal in a vacuum chamber.

DL2.1.66. Monofilament (Monfil). A single filament of indefinite length. Monofilaments are generally produced by extrusion. Their outstanding uses are in the fabrication of bristles, surgical sutures, fishing leader, tennis racquet strings, screen materials,ropes and nets; the finer monofilaments are woven and knitted on textile machinery.

DL2.1.67. Monomer. A relatively simple compound that can react to form a polymer. See also Polymer.

DL2.1.68. Nonpolar. Having no concentrations of electrical charge on a molecular scale, thus, incapable of significant dielectric loss. Examples among resins are polystyrene and polyethylene.

DL2.1.69. Non-Rigid Plastic. A non-rigid plastic is one that has a stiffness or apparent moduus of elasticity of not over 50,000 p.s.i. at 25°C. when determined according to ASTM test procedures D747-43T.

DL2.1.70 Novolac. A phenolic-aldehyde resin which, unless a source of methylene groups is added, remains permanently thermoplastic. See also Resinoid and Thermoplastic.

DL2.1.71. Nylon. The generic name for all synthetic fiber forming polyyamides; they can be formed into monofilaments and yarns characerized by great toughness, strength and elasticty, high-melting point, and good resistance to water and chemicals.

DL2.1.72. Organosol. A vinyl or nylon dispersion, the liquid phase of which contains one or more organic solvents. See also Plastisol.

DL2.1.73. Parison. The hollow plastic tube from which a container, toy, etc., is blow molded.

DL2.1.74. Phenolic Resin. A synthetic resin produced by the condensation of an aromatic alcohol with an aldehyde, particularly of phenol with formaldehyde.

DL2.1.75. Photo-degradation. The breaking down of a plastic molecular structure by absorption of ultraviolet energy. The plastic absorbs high-photon energy, which breaks the bond between carbon and hydrogen, forming oxygen reactive free radicals that promote decomposition.

DL2.1.76. Plastic. One of many high-polymeric substances, including both natural and synthetic products, but excluding the rubbers. At some stage in its manufacture every plastic is capable of flowing, under heat and pressure, if necessary, into the desired final shape. Made of plastic; capable of flow under pressure or tensile stress.

DL2.1.77. Plasticate. To soften by heating or kneading. Synonyms are: plastify, flux, and, (imprecisely) plasticize.

DL2.1.78. Plasticity. The quality of being able to be shaped by plastic flow.

DL2.1.79. Plasticize. To soften a material and make it plastic or moldable, either by means of a plasticizer or the application of heat.

DL2.1.80. Plasticizer. Chemical agent added to plastic compositions to make them softer and more flexible.

DL2.1.81. Plastics Tooling. Tools; e.g., dies, jigs, fixtures, etc., for the metal forming trades constructed of plastics, generally laminates or casting materials.

DL2.1.82. Plastigel. A plastisol exhibiting gel-like flow properties.

DL2.1.x83. Plastisols. Mixtures of resins and plasticizers that can be molded, cast, or converted to continuous films by the application of heat. If the mixtures contain volatile thinners also, they are known as Organosols.

DL2.1.84. Plastometer. An instrument for determing the flow properties of a thermoplastic resin by forcing the molten resin through a die or orifice of specific size at a specific temperature and pressure.

DL2.1.85. Polyamide. A polymer in which the structural units are linked by amide or thioamide groupings. Many polyamides are fiber-forming.

DL2.1.86. Polyblends. Colloquial term generally used in the styrene field apply to mechanical mixtures of polystyrene and rubber.

DL2.1.87. Polycarbonate Resins. Polymers derived from the direct reaction between aromatic and aliphatic dihydroxy compounds with phosgene or by the ester exchange reaction with appropriate phosgen derived precursors.

DL2.1.88. Polyester. A resin formed by the reaction between a dibasic acid and dihydroxy alcohol, both organic. Modification with multi-functional acids and/or bases and some unsaturated reactants permit cross-linking to thermosetting resins. Polyesters modified with fatty acids are called Alkyds.

DL2.1.89. Polyethylene (Polythene). A thermoplastic material composed of polymers of ethylene. It is normally a translucent, tough, waxy solid that is unaffected by water and by a large range of chemicals. It is a particularly good insulating material with low power factor and low dielectric constant, high resistivity, and high dielectric strength.

DL2.1.90. Polyisobutylene. The polymerization product of isobutylene. It varies in consistency from a viscous liquid to a rubber-like solid with corresponding variation in molecular weight from 1,000 to 400,000.

DL2.1.91. Polymer. A high molecular-weight organic compound, natural or synthetic, whose structure can be represented by a repeated small unit, the mer; e.g., polyethylene, rubber, cellulose. Synthetic polymers are formed by addition or condensation polymerization of monomers. If two or more monomers are involved, a copolymer is obtained. Some polymers are elastomers, some plastics.

DL2.1.92. Polymerization. A chemical reaction in which the molecules of a monomer are linked together to form large molecules whose molecular weight is a multiple of that of the original substance. When two or more monomers are involved, the process is called co-polymerization or hetero-polymerization. See also Condensation and Polymer.

DL2.1.93. Polymethyl Methaciylate. A thermoplastic material composed of polymers of methyl methacrylate. It is a transparent solid with exceptional optical properties and good resistance to water. It is obtainable in the form of sheets, granules, solutions, and emulsions. It is extensively used for aircraft domes, lighting fixtures, decorative articles, etc. It is also used in optical instruments and surgical appliances.

DL2.1.94. Polypropylene. A tough, lightweight rigid plastic made by the polymerization of high-purity propylene gas in the presence of an organometallic catalyst at relatively low pressures and temperatures.

DL2.1.95. Polystyrene. A water-white thermoplastic produced by the polymerization of styrene (vinyl benzene). The electric insulating properties of polystyrene are outstandingly good and the material is relatively unaffected by moisture. In particular the power loss factor is extremely low over the frequency range 10^3-10^8 c.p.s.

DL2.1.96. Polyvinyl Acetate. A thermoplastic material composed of polymers of vinyl acetate in the form of a colorless solid. It is obtainable in the form of granules, solutions, latices, and pastes, and is used extensively in adhesive, for paper and fabric coatings, and in bases for inks and lacquers.

DL2.1.97. Polyvinyl Alcohol. A thermoplastic material composed of polymers of the hypothetical vinyl alcohol. Usually a colorless solid, insoluble in most organic solvents and oils, but soluble in water when the content of hydroxy groups in the polymer is sufficiently high The product is normally granular. It is obtained by the partial hydrolysis or by the complete hydrolysis of polyvinyl esters, usually by the complete hydrolysis of polyvinyl acetate. It is mainly used for adhesives and coatings.

DL2.1.98. Polyvinyl Butyral. A thermoplastic material derived from a polyvinyl ester in which some or all of the acid groups have been replaced by hydroxyl groups and some or all of these hydroxyl groups replaced by butyral groups by reaction with butyraldhyde. It is a colorless, flexible, tough solid. It is used primarily in interlayers for laminated safety glass.

DL2.1.99. Polyvinyl Chloride (PVC). A themoplastic material composed of polymers of vinyl chloride; a colorless solid with outstanding resistance to water, alcohols, and concentrated acids and alkalies. It is obtainable in the form of granules, solutions, latices, and pastes. Compounded with plasticizers it yields a flexible material superior to rubber in aging properties. It is widely used for cable and wire coverings, in chemical plants, and in the manufacture of protective garments.

DL2.1.100. Polyvinyl Chloride Acetate. A thermoplastic material composed of co-polymers of vinyl chloride and vinyl acetate; a colorless solid with good resistance to water, concentrated acids and alkalies. It is obtainable in the form of granules, solutions, and emulsions. Compounded with plasticizers it yields a flexible material superior to rubber in aging properties. It is widely used for cable and wire coverings, in chemical plants, and in protectve garments.

DL2.1.101. Polyvinylidene Chloride. A thermoplastic material composed of polymers of vinylidene chloride (l,l-dichloroethylene). It is a white powder with softening temperature at 185-200°C. The material is also supplied as a co-polymer with acrylonitrile or vinyl chloride, giving products that range from the soft flexible type to the rigid type. Also known as saran.

DL2.1.102. Prepreg. A term generally used in reinforced plastics to mean the reinforcing material containing or combined with the full complement of resin before molding.

DL2.1.x103 Pulp. A form of cellulose obtained from wood or other vegetable matter by prolonged cooking with chemicals.

DL2.1.104. Resiliency. Ability to quickly regain an original shape after being strained or distorted

DL2.1.105. Resin. Any of a class of solid or semi-solid organic products of natural or synthetic origin, generally of high molecular weight with no definite melting point. Most resins are polymers.

DL2.1.106. Resinoid. Any of the class of thermosetting synthetic resins, either in their initial temporarily fusible state or in their final infusible state.

DL2.1.107. Rigid PVC. Polyvinyl chloride or a polyvinyl chloride/acetate co-polymer characterized by a relatively high degree of hardness; it may be formulated with or without a small percentage of plasticizer.

DL2.1.108. Rigid Resin. One having modulus high enough to be of practical importance; e.g., 10,000 p.s.i. or greater.

DL2.1.109. Rosin. A resin obtained as a residue in the distillation of crude turpentine from the sap of the pine tree (gum rosin) or from an extract of the stumps and other parts of the tree (wood rosin).

DL2.1.110. Rubber. An elastomer capable of rapid elastic recovery after being stretched to at least twice its length at temperatures from 0°F to 150°F. at any humidity. Specifically, Hevea or natural rubber, the standard of comparison for elastomers.

DL2.1.111. Scrap. Any product of a molding operation that is not part of the primary product. In compression molding, this includes flash, culls, runners, and is not reusable as a molding compound. Injection molding and extrusion scrap (runners, rejected parts, sprues, etc.) can usually be reground and remolded.

DL2.1.112. Sheet (Thermoplastic). A flat section of a thermoplastic resin with the length considerably greater than the width and 10 mils or greater in thickness.

DL2.1.113. Shot. The yield from one complete molding cycle, including scrap.

DL2.1.114. Silicone. One of the family of polymeric materials in which the recurring chemical group contains silicon and oxygen atoms as links in the main chain. At present these compounds are derived from silica (sand) and methyl chloride. The various forms obtainable are characterized by their resistance to heat.

DL2.1.115. Sintering. In forming articles from fusible powders; e.g., nylon, the process of holding the pressed powder article at a temperature just below its melting point for about 1/2 hour. Particles are fused (sintered) together, but the mass, as a whole, does not melt.

DL2.1.116. Sizing. The process of applying a material to a surface to fill pores and thus reduce the absorption of the subsequently applied adhesive or coating or to otherwise modify the surface. Also, the surface treatment applied to glass fiber used in reinforced plastics. The material used is sometimes called "size."

DL2.1.117. Solubility. Plastics that become completely soluble in water forming nontoxic homogeneous solutions. The degree of solubility varies considerably with plastic formulation, temperature, solvent concentration and solvent.

DL2.1.118. Solvent. Any substance, usually a liquid, which dissolves other substances.

DL2.1.119. Stabilizer. An ingredient used in the formulation of some plastics, especially elastomers, to assist in maintaining the physical and chemcial properties of the compounded materials at their initial values throughout the processing and service life of the material.

DL2.1.120. Stereo-specific Plastics. Implies a specific or definite order of arrangement of molecules in space. This ordered regularity of the molecules in contrast to the branched or random arrangement found in other plastics permits close packing of the molecules and leads to high crystallinity (e.g., as a polypropylene).

DL2.1.121. Tenacity (gpd). The term generally used in yarn manufacture and textile engineering to denote the strength of a yarn or of a filament for its given size. Numerically it is the grams of breaking force per denier unit of yarn or filament size; grams per denier, gpd. The yarn is usually pulled at the rate of 12 inches per minute. Tenacity equals breaking strength (gms) divided by denier.

DL2.1.122. Tensile Strength. The pulling stress, in p.s.i., required to break a given specimen. Area used in computing strength is usually the original, rather than the necked down area.

DL2.1.123. Thermal Conductivity. Ability of a material to conduct heat; physical constant for quantity of heat that passes through unit cube of a substance in unit of time when difference in temperature of two faces is 1°.

DL2.1.124. Thermoforming. Any process of forming thermoplastic sheet that consists of heating the sheet and pulling it down onto a mold surface.

DL2.1.125. Thermo forms. The product that results from a thermo-forming operation.

DL2.1.126. Thermoplastic. Capable of being repeatedly softened by heat and hardened by cooling a material that will repeatedly soften when heated and harden when cooled Typical of the thermoplastics family are the styrene polymers and co-polymers, acrylics, cellulosics, polyethylenes, vinyls, nylons, and the various fluorocarbon materials.

DL2.1.127. Thermoset. A material that will undergo or has undergone a chemical reaction by the action of eat, catalysts, ultra violet light, etc., leading to a relatively infusible state. Typical of the plastics in the thermosetting family are the aminos (melamine and urea), most polyesters, alkyds, epoxies, and phenolics.

DL2.1.128. Thixotropic. Said of materials that are gel-like at rest, but fluid when agitated. Liquids containing suspended solids are apt to be thixotropic. Thixotropy is desirable in paints.

DL2.1.129. Transfer Molding. A method of molding thermosetting materials, in which the plastic is first softened by heat and pressure in a transfer chamber, then forced by high pressure through suitable sprues, runners, and gates into closed mold for final curing.

DL2.1.130. Ultrasonic Sealing. A film sealing method in which sealing is accomplished through the application of vibratory mechanical pressure at ultrasonic frequencies (20 to 40 kc.). Electrical energy is converted to ultrasonic vibrations through the use of either a magnetostrictive or piezoelectric transducer. The vibratory pressures at the film interface in the sealing area develop localized heat losses that melt the plastic surfaces effecting the seal.

DL2.1.131. Unsaturated Compounds. Any compound having more than one bond between two adjacent atoms, usually carbon atom, and capable of adding other atoms at that point to reduce it to a single bond.

DL2.1.132. Urea Formaldehyde Resin (Urea Resin). A synthetic resin derived from the reaction of urea (carbamide) with formaldehyde or its polymers.

DL2.1.133. Urethane. See description under Isocyanate Resins.

DL2.1.134. Vacuum Forming. Method of sheet forming in which the plastic sheet is clamped in a stationary frame, heated, and drawn down by a vacuum into a mold. In a loose sense, it is sometimes used to refer to all sheet forming techniques, including drape forming, involving the use of vacuum and stationary molds.

DL2.1.135. Vacuum Metalizing. Process in which surfaces are thinly coated with metal by exposing them to the vapor of metal that has been evaporated under vacuum (one millionth of normal atmospheric pressure).

DL2.1.136. Vinyl Resin. A synthetic resin formed by the polymerization of chemical compounds containing the group CH^2=CH-. In particular, polyvinyl chloride, acetate, alcohol, and butyral, are referred to (though most addition polymers are within the above definition, it is seldom applied to any but the ones listed).

DL2.1.137. Viscosity. Internal friction or resistance to flow of a liquid. The constant ratio of shearing stress to rate of shear. In liquids for which this ratio is a function of stress, the term "apparent viscosity" is defined as this ratio.

DL2.1.138. Welding. Joining thermoplastic pieces by one of several heat softening processes. In hot-gas welding, the material is heated by a jet of hot air or

inert gas directed from a welding "torch" onto the area of contact of the surfaces that are being welded. Welding operations to which this method is applied normally require the use of a filler rod. In spin welding, the heat is generated by friction. Welding also includes heat sealing and the terms are synonymous in some foreign countries, including Britain.

DL2.1.139. Wet Strength. The strength of paper when saturated with water, especially used in discussions of processes whereby the strength of paper is increased by the addition, in manufacture, of plastics resins. Also, the strength of an adhesive joint determined immediately after removal from a liquid in which it has been immersed under specified conditions of time, temperature, and pressure.

DL2.1.140. Working Life. The period of time during which liquid resin or adhesive, after mixing with catalyst, solvent, or other compounding ingredients, remains usable.

C1. CHAPTER 1

INTRODUCTION

C1.1. GENERAL

The security and defense of the United States requires a massive expenditure of our natural resources; and the rapid pace of technological advances in military equipment and repair parts will generate even greater resource requirements in the future. Efficient recovery and recycling of this property, after it is no longer usable, is of the utmost importance to recover strategic and critical materials and precious metals needed for manufacture of essential military material and consumer goods and to conserve our natural resources and energy in the production process.

C1.2. PURPOSE

The purpose of this Handbook is to outline practical, cost-effective methods for the recovery and recycling of scrap (defined as personal property that has been discarded for use and that appears to have no value except for its basic material content). By providing the best available technical guidance to all interested components of the Department of Defense on scrap identification and segregation, scrap yard operations and merchandising of scrap, it is intended that this Handbook will result in worldwide DoD implementation of proven methods to increase the payback from the DoD Scrap Recycling Program.

C1.3. OBJECTIVES

The broad objectives of the DoD Scrap Recycling Program are to:

C1.3.1. Ensure that no property with utilization or sales value that exceeds the value of its material content is processed as scrap.

C1.3.2. Optimize procedures for cost-effective recovery, recycling, or sales of scrap, including precious metal-bearing materials.

C1.3.3. Ensure processing of scrap is in strict compliance with all applicable safety, health regulations and environmental protection guidelines.

C1.4. RESPONSIBILITIES OF DoD ACTIVITIES

C1.4.1. General. The Federal Property and Administrative Services Act of 1949, as amended, assigned to the Administrator of General Services responsibility for the disposition of excess and surplus personal property (including scrap) generated by Federal Agencies in the United States. The Administrator delegated responsibility for disposition of all DoD generations of such property to the Secretary of Defense, who subsequently assigned overall command and management of the Defense Personal Property Utilization and Disposal Program to the Defense Logistics Agency. Specific responsibilities of the DoD activities primarily concerned with scrap recycling are outlined below.

C1.4.2. Military Services' Responsibilities:

C1.4.2.1. Provide administrative and logistics support to tenanted Defense Property Disposal Regional Offices (DPDRs) and to Defense Property Disposal Offices (DPDOs) and their Off-Site Branches, in consonance with applicable Interservice Support Agreements (ISAs). The U.S. Army Logistics Management Center also provides specialized training support by conducting the Defense Scrap Management Course.

C1.4.2.2. Establish and operate the DoD Resource Recovery and Recycling Programs, Deputy Secretary of Defense Memorandum, Sales of Recyclable Materials (10 U.S.C. 2577), 28 Jan 83.

C1.4.2.3. Establish Qualifying Recycling Programs at DoD installations including those that operate under the industrial fund.

C1.4.2.4. Ensure that those installations and Defense Agencies with Qualifying Recycling Programs make concerted efforts to divert or recover scrap or waste from the waste streams, as well as efforts to identify, collect, properly segregate and maintain the integrity of the recyclable materials in order to maintain or enhance the marketability of the materials.

C1.4.2.5. Report/turn in all authorized scrap generations to their servicing DPDOs.

C1.4.2.6. Prepare disposal turn-in documents, DTID (DD Form 1348-1 DoD Single Line Item Release/Receipt Document) and accurately identify all scrap listed thereon.

C1.4.2.7. Indicate on DTID that DoD Qualifying Recycling Program material is identified as such with funds to be deposited to the Budget Clearing Account **F3875--- (xx 17 Navy, 21 Army, 57 Air Force and 97 for DoD Activities). No other account is acceptable.

C1.4.2.8. Properly containerize all hazardous property in scrap condition before turn-in. Identify by labeling containers and annotate DD Form 1348-1 accordingly.

C1.4.2.9. Monitor, with DPDO personnel, all property sent to landfills to ensure no economically salable or recyclable property is discarded.

C1.4.2.10. Request DPDS provide sales services, as needed, for recyclable marketable materials generated as a result of resource recovery programs.

C1.4.3. Defense Logistics Agency (DLA) Responsibilities:

C1.4.3.1. Coordinate DoD policy guidance (developed by the Assistant Secretary of Defense (Manpower, Installations, and Logistics) or other organizational elements of the Office of the Secretary of Defense) with the Military Services and other DoD Components, and with Federal Civil Agencies, as appropriate.

C1.4.3.2. Program, budget, fund, account for, allocate and control personnel spaces and other resources required to support DLA scrap recycling activities.

C1.4.3.3. Provide Agency-level command and control of the Defense Personal Property Utilization and Disposal Program (including scrap recycling and precious metals recovery) worldwide.

C1.4.4. Defense Property Disposal Service (DPDS) Responsibilities:

C1.4.4.1. Manage the DoD Scrap Recycling Program (including precious metals recovery) and related financial records.

C1.4.4.2. Command and control DPDRs.

C1.4.4.3. Implement applicable policies, develop procedures and techniques, and initiate other appropriate actions to ensure cost-effective and environmentally safe implementation of scrap related programs.

C1.4.4.4. Comply with DoD guidance on demilitarization of scrap generations.

C1.4.4.5. Provide technical guidance to DPDRs regarding equipment procurement and development of facilities required to enhance program effectiveness.

C1.4.4.6. Maintain and control the Consolidated DoD Bidders List.

C1.4.4.7. Respond to private and public sector inquiries pertaining to the recovery and sale of scrap.

C1.4.4.8. Provide sales services and marketing advice to the Military Services on the operation of DoD Directive 4165.60, "Solid Waste Management-Collection Disposal, Resource Recovery Recycling Program."

C1.4.5. Defense Property Disposal Regions (DPDRs) Responsibilities:

C1.4.5.1. Supervise and provide administrative and technical support to assigned sales office(s) and DPDOs.

C1.4.5.2. Coordinate, develop and implement required ISAs with DoD Components.

C1.4.5.3. Conduct sales and provide related contracting support.

C1.4.5.4. Provide appropriate command guidance and technical assistance to DPDOs.

C1.4.5.5. Assist all assigned organizational elements to obtain needed equipment and facilities.

C1.4.5.6. Ensure that scrap is handled and stored in strict compliance with applicable safety, health, and environmental protection guidelines, as well as security procedures.

C1.4.5.7. Monitor compliance with DoD guidance on the demilitarization of scrap.

C1.4.6. Defense Property Disposal Offices (DPDOs) Responsibilities:

C1.4.6.1. Provide technical assistance to generating activities in the identification, segregation, collection, and storage of scrap at its source and, where feasible, provide containers to the scrap generator.

C1.4.6.2. Receive authorized scrap generations.

C1.4.6.3. Ensure adequate storage and security for scrap receipts.

C1.4.6.4. Dispose of scrap in such a way as to maximize net return to the Government.

C1.4.6.5. Perform market research to determine best sales method and optimum lot sizes.

C1.4.6.6. Inspect DoD Component landfills to ensure that no salable property or recyclable scrap (including precious metal-bearing scrap) is abandoned.

C1.4.6.7. Optimize procedures for recovery of strategic and critical materials (including precious metals) from scrap generations.

C1.4.6.8. Ensure that scrap is handled and stored in strict compliance with applicable safety, health, and environmental protection guidelines, as well as security procedures.

C1.4.6.9. Comply with DoD guidance on demilitarization of scrap.

C1.4.7. Defense Property Disposal Precious Metals Recovery Program: As operational manager for recovery aspects of the Precious Metals Recovery Program (PMRP), DPDS provides recovery equipment to generating activities on a non-reimbursable basis, issues disposition instructions for the movement of precious metal-bearing materials to collection/recovery sites, and performs contracting and contracting support functions regarding the recovery of precious metals by commercial refiners. As secondary-level field activities reporting to DPDS, the DPDRs, through assigned Precious Metals Area Representatives (PMARs) provide technical support to DoD and participating Federal Civil Agency-generating activities and DPDOs and assist them in improving the cost effectiveness of the PMRP.

C1.4.8. Defense Industrial Supply Center (DISC) Responsibilities: As integrated DoD manager for fine precious metals, DISC is responsible for storage and issue of refined precious metals recovered through the PMRP. Costs incurred by DPDS are totally reimbursed by DISC from the Defense Stock Fund.

C1.4.9. Defense Contract Administration Services (DCAS) Responsibility: DCAS and its subordinate Defense Contract Administration Services Regions (DCASRs), Defense Contract Administration Services Management Areas (DCASMAs), and Defense Contract Administration Services Plant Representative Offices (DCASPROs), under the direction of the Director, DLA, administer assigned contracts, including those

that require contractors to dispose of scrap generated from work specified in their contracts.

C2. CHAPTER 2

A SCRAP OVERVIEW

C2.1. GENERAL

Thus far the term "scrap" has been used in a general sense. In the scrap recycling industry, the word "scrap" usually applies only to ferrous metal materials (iron or steel), which have no value except for their basic material content. "Metals" is the term the scrap recycling industry uses to describe nonferrous scrap, such as brass, copper, stainless steels, high-temperature alloys, lead, zinc, aluminum, magnesium, manganese, cobalt, chromium, tin, nickel, cadmium, tungsten, titanium, mercury, and the precious metals. Other scrap, such as textiles, paper, plastics, chemicals, used or contaminated petroleum products, used synthetic lubricants, used solvents, rubber, leather, wood, and food residue are referred to as nonmetallic scrap. In the Department of Defense, the term "waste" means used or unused property, residues, by-products, sludges, and other materials that have no known utility and, therefore, must be discarded.

C2.2. FERROUS SCRAP

C2.2.1. Although the terms iron" and "steel" are frequently used interchangeably, they are not the same. Both iron and steel belong to the ferrous family, and their basic content is the element iron, but iron and steel are quite different materials.

C2.2.2. Iron has a rather high carbon content; and it is cast into molds to produce such items as automobile motor blocks. It tends to have a granular structure, like an apple.

C2.2.3. Steel is also iron, but has been refined to eliminate most of the carbon. Steel can be either carbon steel or alloy steel. Carbon steel, the most common type of steel, varies in carbon content, the higher the carbon content, the harder the steel. Alloy steels are iron-based, but contain varying amounts of other elements (such as chromium, nickel, manganese, silicon, vanadium or molybdenum) that are added to provide heat, wear, and/or corrosion resistance. Stainless steel, for example, is an alloy steel that contains various percentages of nickel and chromium. Steel is generally fibrous, something like celery. It may be produced in the form of steel castings or rolled into such products as bars, structural shapes, plates, sheets, pipe and rails.

C2.2.4. Use of iron and steel scrap, which has a much lower carbon content than raw pig iron produced from iron ore, shortens the melting process in all types of

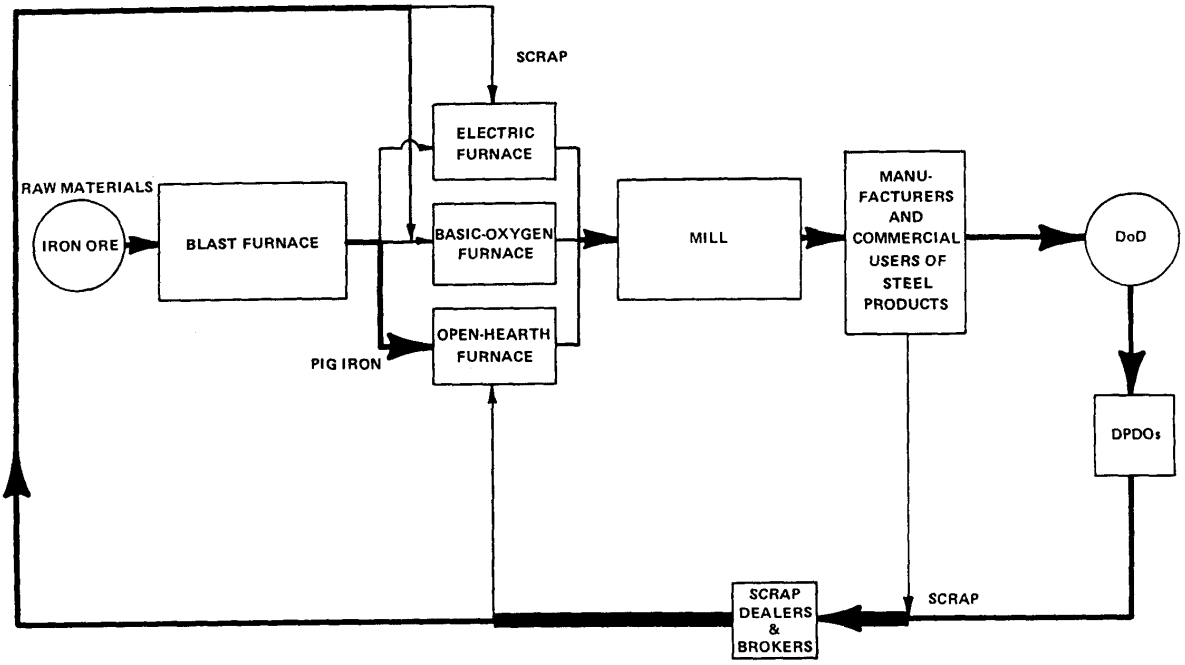
furnaces and thus, significantly reduces energy requirements and other costs involved in the manufacture of iron and steel products. Moreover, iron or steel manufactured from recycled ferrous scrap usually results in a better end product than that produced solely from raw pig iron, no matter how old or rusted the scrap may be.

C2.2.5. Four types of furnaces--open-hearth, electric, basic oxygen, and blast--constitute the principal producing units of today's steel industry. (See Figure C2.F1.)

C2.2.5.1. The blast furnace is primarily used to reduce iron ore into pig iron or "hot metal." When iron from the blast furnace is cast and chilled into molds, it is called pig iron. When it is tapped into a ladle and conveyed directly to an open-hearth furnace for refining into steel, it is called hot metal.

C2.2.5.2. Ferrous materials are loaded into open-hearth furnaces either as a "cold" charge (usually iron and steel scrap) and/or a "hot metal" charge of molten iron. About 41-43 percent of the total ferrous input to open-hearth furnaces is scrap. Limestone is used for the bottom layer of the furnace to draw off impurities. Then iron ore, scrap, and hot metal are added, in that order, on top of the limestone. Before the melting process is completed, more scrap and hot metal are usually added. The tremendous heat that passes over this molten bath vaporizes impurities or attracts them to the top as slag. After 8 or 9 hours, the slag on top is tapped off and the steel is poured into a ladle for casting into ingots.

Figure C2.F1. Ferrous Scrap Cycle



C2.2.5.3. Basic oxygen furnaces that employ the Linz-Donawitz (L-D) process (in which the bath of molten metal is lanced with a jet of oxygen) use only about 25-30 percent scrap. Because of their relatively low cost of construction and operation (as compared to open-hearth furnaces) and the fact that they require less than 1 hour per heat, L-D capacity throughout the world is increasing.

C2.2.5.4. Electric furnaces that use electric energy for heat are operated as a non-oxidizing melting furnace that can accept up to a 100 percent charge of scrap under certain conditions. (Normally, however, a charge of about 96 percent scrap and four percent pig iron is used.) Because of their low energy consumption and the low initial capital outlay required, these furnaces are also assuming an increased share of world steel production.

C2.2.6. Segregation of most ferrous scrap (iron and carbon steel) is based more on the physical dimensions of the scrap rather than on the chemical composition of the scrap. However, in the case of alloy steel scrap (see Chapter 5), segregation should be based primarily on its alloying constituents.

C2.3. NONFERROUS SCRAP

C2.3.1. The term "nonferrous scrap" applies to all metallic scrap, except that which consists primarily of iron and steel. Because of the fact that we must depend on foreign sources for supply of a large portion of our requirements for nonferrous metals, and because of the high market price of nonferrous scrap per unit of weight, the handling of nonferrous scrap deserves top priority attention by all concerned.

C2.3.2. Nonferrous metals have unique individual properties and characteristics, such as high corrosion resistance, lightness with strength, high reflectability, electrical and thermal conductivity; excellent bearing qualities, and spark resistance. The strength, hardness, and elasticity of nonferrous metals varies with the type of alloying constituents and the exact percentage of each used in the alloying process. A variation of only a few tenths of one percent in one element of the alloy may significantly change the physical characteristics of the alloy.

C2.3.3. Most of the complexity that smelters encounter when using nonferrous scrap is a result of contamination caused by improper segregation and classification. When nonferrous scrap is kept clean, properly classified, and free from contamination with other materials, it can be used to produce an ingot that compares favorably for many purposes with a virgin ingot. Conversely, any degree of contamination will seriously degrade the value of otherwise good scrap for use in producing a fully acceptable alloy. Specifications for all nonferrous alloys are very definite and strict. The mixture of any quantity of off-grade scrap can contaminate a pile of otherwise good quality scrap. When this occurs in the remelting process, the entire melt must be upgraded by adding more precisely identified metals (e.g., copper, tin) to bring the alloy up to standard specifications.

C2.4. NONMETALLIC SCRAP

The recovery of this type of scrap is a vitally important element of the DoD Scrap Recycling Program since it is continuously generated in large quantities at all DoD installations. Although it may not appear to be as glamorous to handle as other types of scrap, it provides much greater benefits (in terms of sales proceeds) because of its higher value per ton than does ferrous scrap. Those segments of the scrap recycling industry concerned with processing nonmetallic scrap are, in many ways, more complex and varied than those concerned with metallic scrap.

C2.5. SCRAP RECYCLING CONSERVES NATURAL RESOURCES

C2.5.1. As indicated at the beginning of Chapter 1, the most important reason for recycling DoD scrap generations is to conserve our rapidly dwindling natural resources, including those required for the production of energy. In addition, the DoD Scrap Recycling Program can contribute significantly to reducing the net cost of other DoD programs by reducing outlays otherwise required to effect environmentally safe abandonment or destruction of hazardous scrap through costly service contracts. This effort returns millions of dollars generated from scrap sales to the U.S. Treasury and DoD activities, and utilizes precious metals recovered from scrap for authorized internal purposes or as Government-Furnished Material (GFM) to DoD contractors.

C2.5.2. A ton of recycled ferrous scrap can replace over one and one fourth tons of iron ore in the production of steel; and recycled nonferrous scrap currently fulfills 25 percent of the aluminum, 50 percent of the copper, 50 percent of lead, and 14 percent of the zinc requirements of the United States. Our metallic scrap resources can therefore truly be considered as "mines above ground." Similarly, paper scrap can be considered as a "secondary forest" since each ton of waste paper replaces over eight-tenths of a ton of wood pulp, and each ton of wood pulp saved by recycling paper scrap is equivalent to an annual growth of pulpwood timber on 1.6 acres of timberland. Thus the total benefits from paper recycling in the United States currently equates to saving 200 million trees annually or 20 percent of the total raw materials used in paper production. If we could increase this rate to 50 percent, each year we could conserve a forest equal in total area to the states of New Jersey, New York, Pennsylvania, and Maryland. Recycling of other nonmetallic scrap, such as textiles, rubber, oil, and chemicals, has a comparable potential for making a significant contribution to our national economy.

C2.5.3. In the area of energy conservation, recycling of ferrous scrap, in lieu of refining iron ore, generates a 60-percent energy savings. For example, the energy saved in producing 1000 tons of steel from ferrous scrap is equivalent to that contained in 140,000 gallons of gasoline. Energy savings resulting from the recycling of nonferrous scrap, in lieu of refining nonferrous ores, range from 60 percent for lead and zinc to 80 percent for copper and 96 percent for aluminum; and recycling of paper and rubber scrap is 60 to 70 percent more energy efficient than is the production of paper and rubber from raw materials. Overall, the National Association of Recycling Industries estimates that at least two percent of total United States energy demand could be met from energy saved simply by recycling available steel, aluminum, and paper scrap.

C2.5.4. Despite the substantial benefits of scrap recycling, as outlined above, in reality the DoD Scrap Recycling Program to date has only addressed the "tip of the

iceberg." It is therefore of vital importance that the Department of Defense, as one of the world's major consumers of scarce natural resources, takes the lead in enhancing the efficiency of its recovery and recycling of scrap.

C3. CHAPTER 3

SCRAP YARD ORGANIZATION

C3.1. GENERAL

The organization and mission of each DoD scrap recycling activity varies depending on the quantity and type of scrap recovered, the layout and quality of available physical facilities and equipment, the varying requirements of scrap buyers, and the presence or absence of special legal, political, or environmental constraints. Therefore, rather than arbitrarily suggesting specific scrap yard models to which each DoD scrap yard should conform, this Handbook classifies scrap yards into three broad, general categories, as follows:

C3.1.1. Type "A" Scrap Yard--Small. This type of scrap yard usually serves small activities (such as recruiting stations, Reserve units, small remote communication stations, or auxiliary air stations), which generate up to 500 tons of scrap per year. The suggested layout of a Type "A" scrap yard is a smaller scale version of the Type "B" yard.

C3.1.2. Type "B" Scrap Yard--Medium. (See Figure C3.F1.) This type of scrap yard serves slightly larger activities that generate from 500 to 2000 tons of scrap per year.

C3.1.3. Type "C" Scrap Yard--Large. (See Figure C3.F2.) This type of scrap yard supports major installations, including those that have large production or repair activities (such as shipyards, supply centers, air bases, large ammunition depots or ordnance plants) that generate more than 2000 tons of scrap per year.

C3.2. FACILITY LAYOUT

Each scrap yard should be designed to minimize scrap handling and to enhance cost effectiveness, wherever feasible, by mechanizing scrap yard operations. Each time a piece of scrap is moved, the cost of handling that piece of scrap increases. Therefore, whenever possible, the "handle it once" rule should apply. Off-loading material from delivery trucks direct to the appropriate scrap pile or lot will eliminate unnecessary duplicate handling. The model layouts of Type A and B yards (Figure C3.F1.) and a Type C yard (Figure C3.F2.) are meant only as guides. In designing new facilities or improving existing facilities, consideration should be given to the following factors:

C3.2.1. Access to Water or Rail Transportation. This will not only facilitate mechanization of scrap yard operations, but may significantly increase sales proceeds by making it possible to market scrap in shipload, bargeload or railcar lots.

C3.2.2. Scrap Yard Office. The scrap yard office should not only provide suitable administrative space, but may also include secure covered storage for high-value scrap (e.g., that containing precious metals), a break and lunch area for scrap yard personnel, and a suitable reception and display area in which to receive customers.

C3.2.3. Truck/Railroad Scales. (See Figure C3.F3.) Since scrap should be weighed when received or released, consideration should be given to locating the scale close to the scrap yard entrance. However, this may not be essential, particularly in a small scrap yard, if a nearby scale is available for scrap yard use. Yards that normally receive and release scrap in small quantities (generally less than 10,000 pounds) should consider the use of accurate platform scales or forklift scales as a substitute for a truck scale.

C3.2.4. Storage Space. One of the most important considerations in scrap yard layout is to identify the quantity arid type of inside and outside storage required. Inside storage is needed for certain types of hazardous material, for high-value scrap requiring special security arrangements, and for scrap that must be protected from exposure moisture or to temperature extremes.

C3.2.4.1. Examples of specific types of scrap that require covered storage include the various grades of paper and textile scrap that must be sold dry, small arms brass that should be protected from corrosion and exposure to undesirable contaminants that substantially reduce their value for reloading, precious metal-bearing electronic scrap, high-temperature alloys, and copper scrap that require storage under controlled conditions of temperature and humidity. (See Figure C3.F4.)

C3.2.4.2. Some forms of scrap (e.g., scrap tires, ferrous scrap) are best stored in open storage because of their bulkiness, low value, or the quantity of generations. (See Figure C3.F5.) Bulky items that are most efficiently stored when palletized may require some form of improved surface to facilitate safe loading, unloading and placement by forklift. Although ferrous scrap can be stored on an unimproved surface, storage on an improved surface will minimize dirt and gravel contamination from loading operations.

Figure C3.F1. Type B Scrap Yard Layout

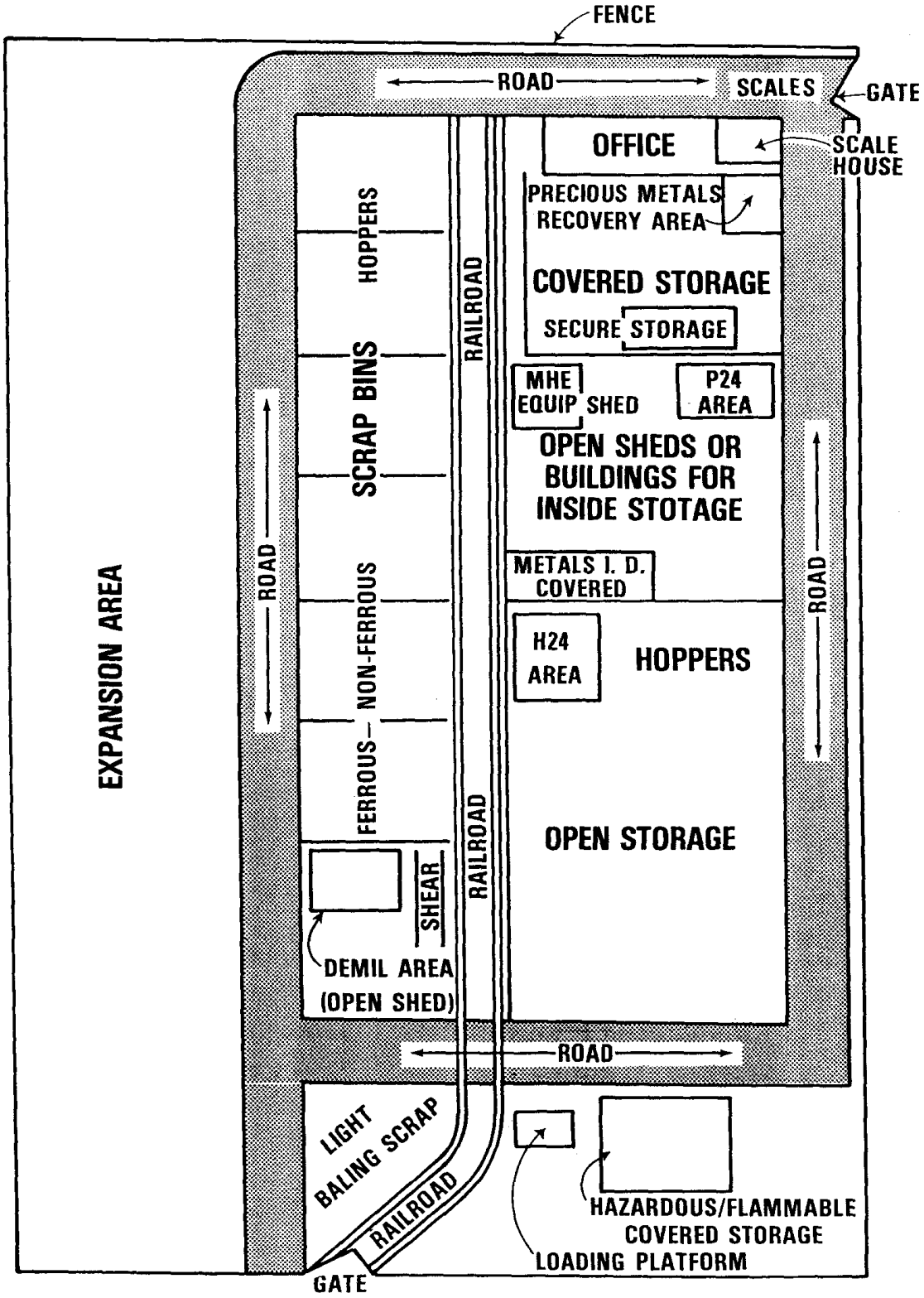


Figure C3.F2. Type C Scrap Yard Layout

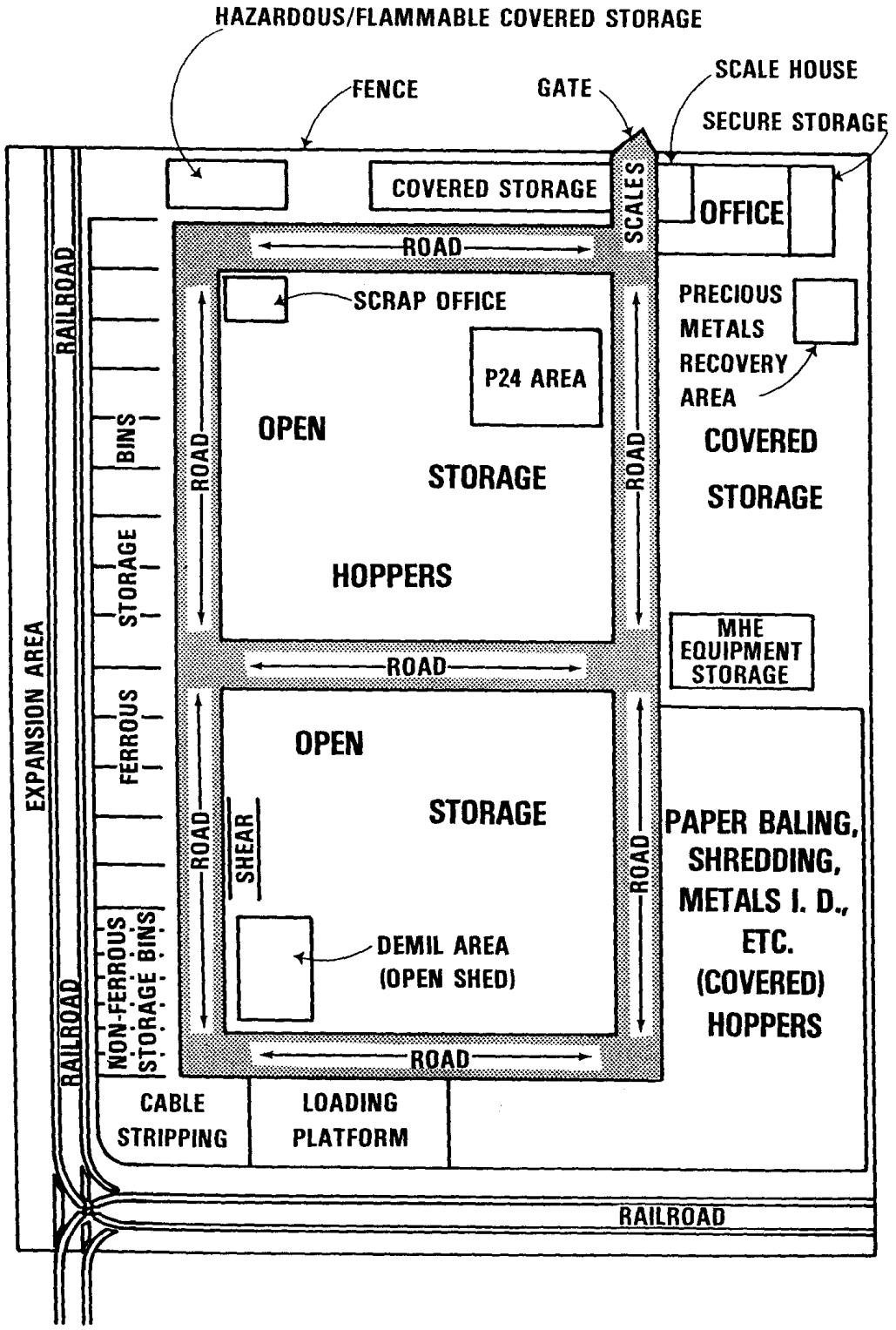


Figure C3.F3. Truck Scale. Scalehouse Located Immediately Adjacent to the Scale

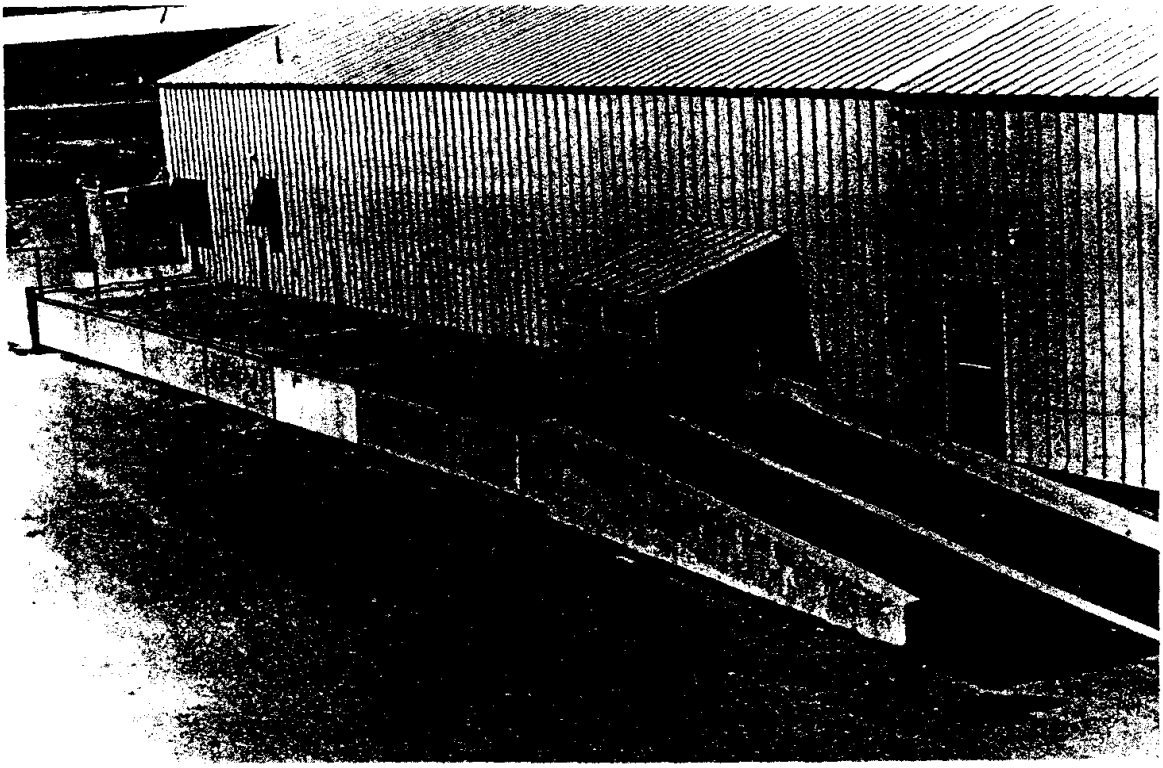


Figure C3.F4. High-Value Scrap Is Accorded Inside Storage When Space Is Available

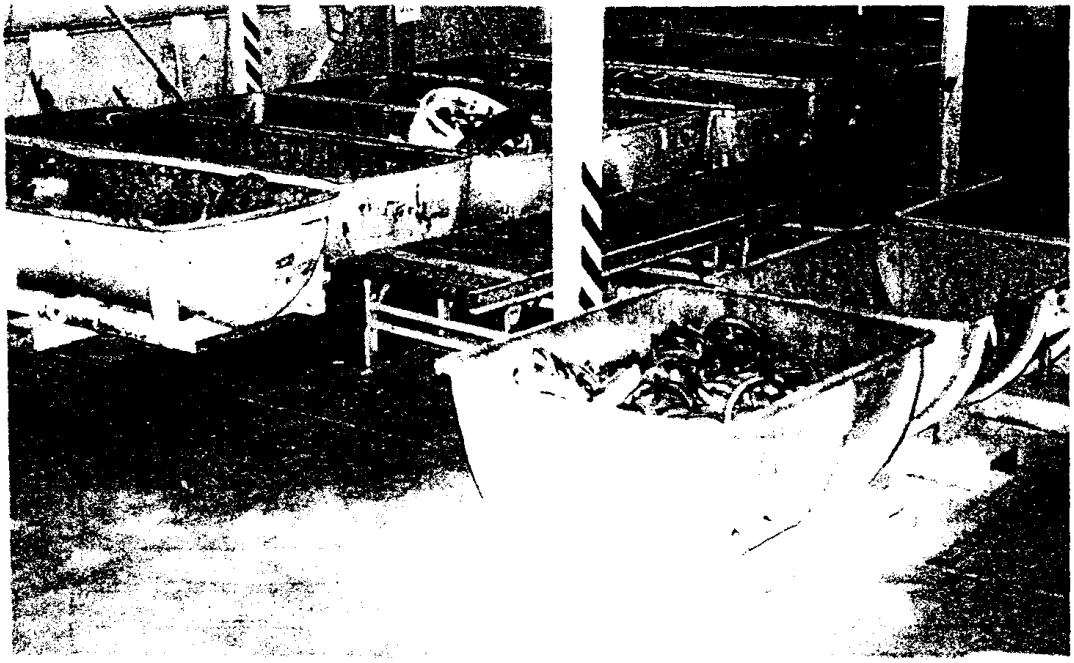


Figure C3.F5. Open Storage Is a Necissity for This Quantity of Ferrous Scrap.

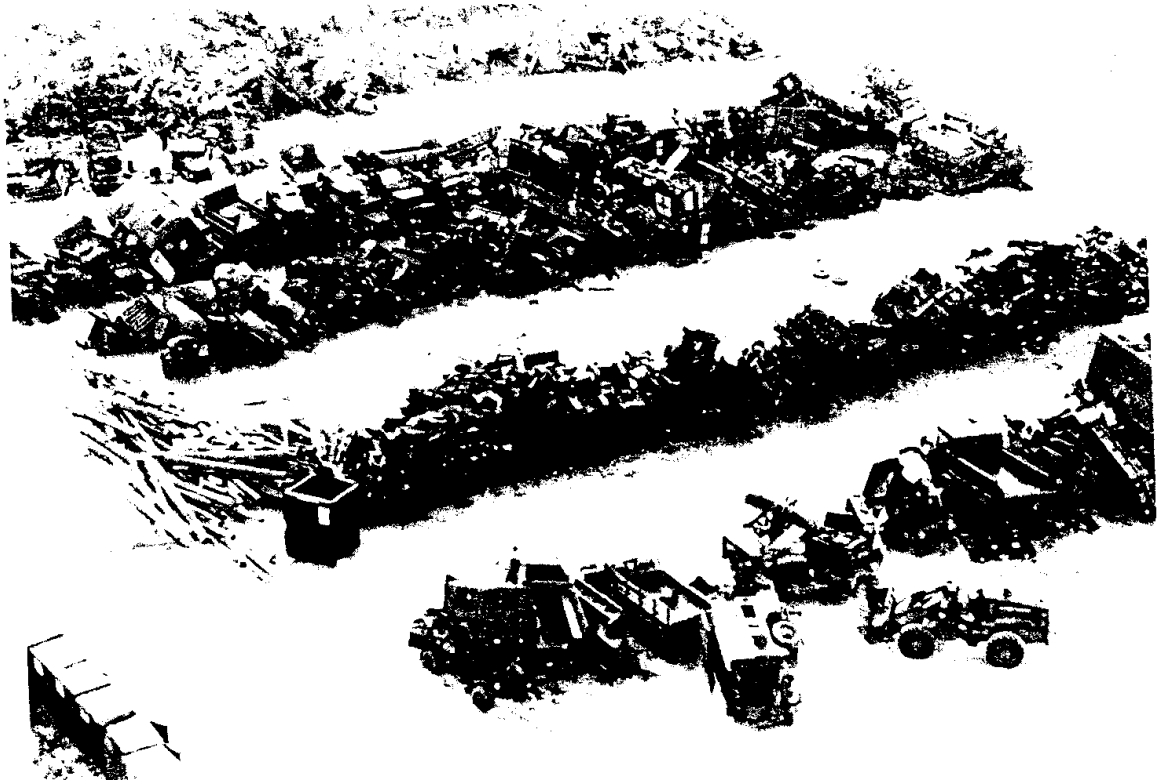
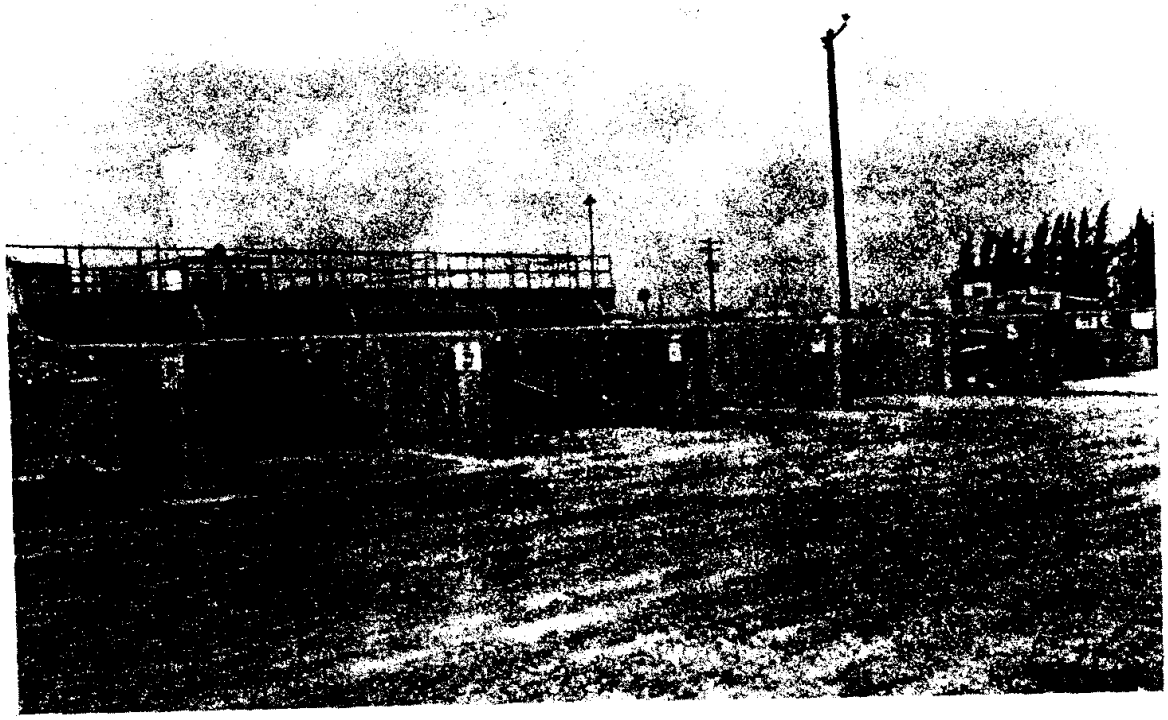


Figure C3.F6. A Modern Scrap Recyclilng Facility With Concrete Bins

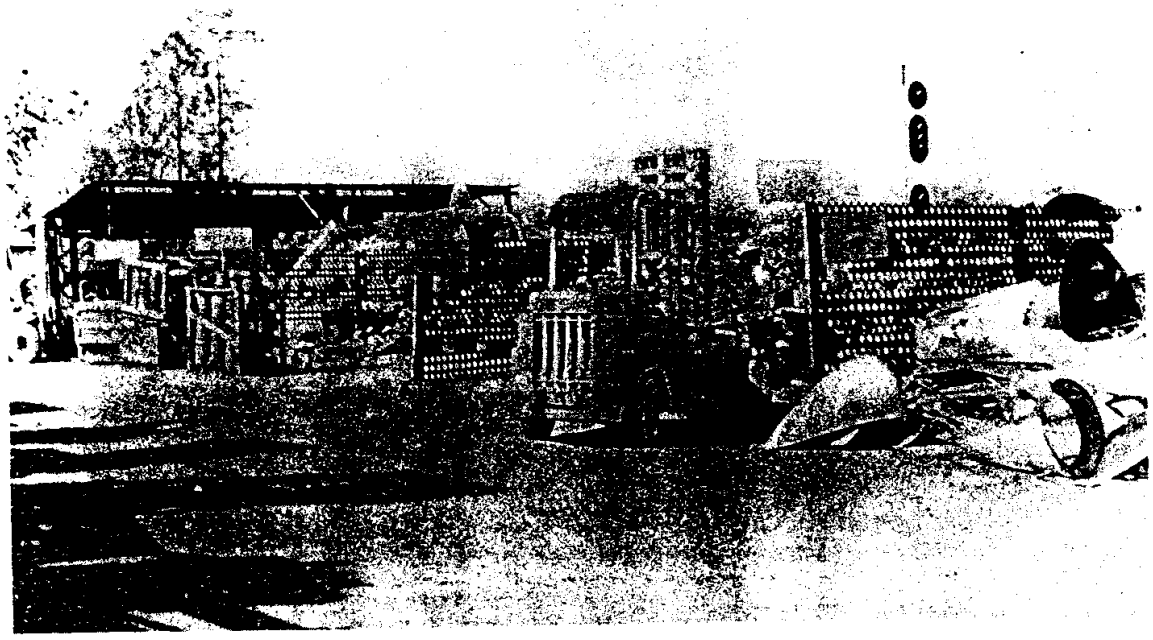


C3.2.4.3. When expected generations of scrap are known and predictable, bin storage is usually the preferred type of storage. Where bins are used, reinforced concrete bins constructed on concrete pads have the advantage of being able to withstand damage inflicted during loading operations, minimize contamination with dirt, and facilitate zeroing-out of scrap inventory. Such bins can also aid in converting yesterday's "junk yard" into today's modern scrap recycling facility. (See Figure C3.F6.) The resulting improvement in the image presented by a DoD scrap yard will be helpful in promoting better public and host-tenant relations, attracting increased buyer participation in DoD scrap sales, and improving the morale of scrap yard employees. Bins may also be constructed of wood, pierced steel planking (PSP), or other locally available materials. (See Figures C3.F7. and C3.F8.) In some cases, where generations fluctuate greatly, it may be desirable to make use of movable dividers, set on concrete pads, to delineate the backs and sides of scrap bins.

C3.2.4.4. Other movable storage devices (such as hoppers, drums, engine or Conex containers) may be used, in addition to scrap bins, in order to minimize manual handling of scrap, store small amounts of high-value scrap, promote source segregation of scrap, and facilitate subsequent segregation of scrap. (See Figures C3.F9. through C3.F22.)

C3.2.4.5. In determining an optimum facility layout, each scrap yard must carefully evaluate its unique functional needs, considering types and amounts of scrap to be handled, types and amounts of equipment needed, geologic and climatic conditions, and locations and suitability of available buildings and grounds. When physical improvements are appropriate, scrap yard personnel must work closely with host engineers to define their construction requirements. Since each new construction project must be well documented, thoroughly justified, and processed through lengthy and time-consuming coordination and approved channels, it is imperative to identify and quantify all costs and benefits, both tangible and intangible, to ensure that it is cost-effective before preparing and submitting a formal project request.

Figure C3.F7. This Scrap Yard, Although Functional, Has Recently Been Upgraded. (See Figure C3.F8.)



C3.3. EQUIPMENT

C3.3.1. Identifying Equipment Needs. Each scrap yard must identify its equipment needs based upon thorough analysis of the following factors:

C3.3.1.1. Safety and health requirements.

C3.3.1.2. Environmental practices conforming to all Federal, State, and local environmental laws.

C3.3.1.3. Type of scrap received.

C3.3.1.4. Frequency and magnitude of scrap generations.

C3.3.1.5. Topographical and climatic conditions.

C3.3.1.6. Facilities layout.

C3.3.1.7. Legal and political constraints.

C3.3.1.8. Availability of qualified equipment operators and suitable equipment maintenance support.

C3.3.1.9. Costs versus benefits.

C3.3.2. Safety Equipment. It is mandatory that every DoD scrap yard be provided with appropriate personal protective equipment (PPE); and the scrap yard manager must ensure that other needed safety equipment is readily available and in continual use. PPE includes items such as safety clothing, gloves, goggles, face shields, hard hats and safety shoes. Included in the category of other needed safety equipment are signs designating areas where the use of PPE is either mandatory or recommended and signs marking the locations of fire extinguishers, eyewashes, and safety showers. Since safety is everyone's business, it is the responsibility of every scrap yard employee to ensure that appropriate PPE is available and properly used. Equipment with safety features (e.g., cages, roll bars, kill switches) should be placed in an inoperative status whenever safety features are not fully functional or effective.

C3.3.3. Equipment Determinations. Equipment for Type A, B, or C scrap yards is not determined solely on the basis of size of the yard, but rather by need. If a Type B yard, which normally would not require a cable stripper, can justify the need and show a cost payback from sale of large quantities of stripped copper wire, that Type B yard should initiate action to obtain this equipment.

C3.3.4. Equipment List. It is not feasible to separately identify the specific equipment needed by a particular scrap yard, since each scrap yard must tailor its equipment inventory so as to optimize its own scrap operations. This means that only needed equipment should be retained, that it meets specific needs of that scrap yard, and that it be efficiently utilized. Tabulated below is a list of basic scrap yard equipment from which each DoD scrap yard should develop its own requirements:

C3.3.4.1. Safety Equipment. There should be sufficient personal protective equipment on hand to meet the needs of all scrap yard employees and scrap yard visitors. In addition, each scrap yard must have its own eyewash unit(s) and shower(s), fire extinguishers, first-aid kits, and signs marking locations of the safety equipment.

C3.3.4.2. Material Handling Equipment (MHE):

C3.3.4.2.1. Cranes, truck/rail-mounted and/or crawler, equipped with magnet(s) for handling ferrous scrap and other appropriate lifting accessories. (See Figures C3.F9. through C3.F12.)

C3.3.4.2.2. Forklifts (see Figures C3.F13. through C3.F15.), in appropriate sizes (e.g., 4,000 lb., 6,000 lb., 15,000 lb.), equipped with puncture-proof tires and appropriate accessories (e.g., rotary head, barrel grabber). Sizes and numbers

of forklifts at each location should be determined by the type, size, and amount of scrap being handled. Local scrap yard facilities and topographic conditions will determine the mix of rough terrain models with standard models, and electric models with internal combustion models.

C3.3.4.2.3. Front-end loaders, wheeled or crawler. In some instances, it may be more cost-effective to use front-end loaders to move scrap than to use cranes.

C3.3.4.2.4. Warehouse tugs may supplement fork lifts, in some instances, for moving and spotting hoppers, engine containers, drums, boxes, and pallets of scrap materials.

C3.3.4.2.5. Trucks, dump, stake-body or pickup--used to move scrap and scrap-yard personnel from site to site when distances are excessive.

C3.3.4.3. Sweepers, magnetic--used to keep paved areas free from excessive dust and stray metal scrap, to avoid foot injuries and damage to MHE tires.

C3.3.4.4. Scales:

C3.3.4.4.1. Rail or truck scales (see Figure C3.F3.) used to measure and record weight of most scrap receipts and dispositions.

C3.3.4.4.2. Platform scales, warehouse-type--used to measure and record weight of high-value scrap received, segregated, and outloaded.

C3.3.4.4.3. Forklift scales--a useful forklift attachment, sometimes more useful than platform scales.

C3.3.4.4.4. Gram scales--used for weighing of fine precious metals.

C3.3.4.5. Processing Equipment:

C3.3.4.5.1. Balers, paper and textile (see Figure C3.F16.) used to facilitate handling of nonmetallic scrap.

C3.3.4.5.2. Balers, metal (see Figure C3.F17.) use of this equipment will reduce storage space requirements and may significantly increase the market value of scrap. Also useful in demilitarizing munitions list items.[1]

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[1] See DoD 4160.21-M-1, "Defense Demilitarization Manual."

C3.3.4.5.3. Shears (see Figure C3.F18.) used for demilitarization of munitions list items, removing nonferrous attachments from ferrous scrap and cutting scrap to manageable size.

C3.3.4.5.4. Cable strippers--used to separate insulating materials from copper wire and cable.

C3.3.4.5.5. Shredders--used to reduce bulk and storage space for scrap metal, rubber, wood, paper, glass and plastics. Makes such scrap more manageable, more economical to move and more valuable.

C3.3.4.5.6. Cutting torches (with appropriate accessories)--substitute for shears.

C3.3.4.5.7. Metal saws--substitute for shears, also used to cut samples for analysis or for inspection by prospective buyers.

C3.3.4.5.8. Power tools--air or electric powered--used for repetitive-type scrap processing operations in place of handtools.

C3.3.4.5.9. Handtools (e.g., hammers, chisels, pry bars, wrenches, pliers, screwdrivers)--used for segregation of high-value scrap and removal of precious metal-bearing scrap from scrapped end items.

C3.3.4.6. Metals Identification Equipment:

C3.3.4.6.1. Small hand magnets--should be available to every scrap yard employee.

C3.3.4.6.2. Acid spot-testing kit--used for making chemical spot-tests on scrap metal samples.

C3.3.4.6.3. Portable or bench grinders--used for spark testing of scrap metals, sharpening tools, and removing scale and oxides from scrap samples.

C3.3.4.7. Metals Identification Instruments: Scrap yards that receive large quantities of high-value metallic scrap may be able to justify procurement of portable test instruments to provide rapid and quite accurate identification and quantitative analysis of the constituent elements of metallic scrap samples. Such instruments employ techniques of optical emission spectrometry, X-ray, radioisotope fluorescence, thermoelectric response, and Eddy current induction for rapid nondestructive analysis.

C3.3.4.8. Portable Storage Aids. (See Figures C3.F19. through C3.F22., and C5.F1., C5.F2.) This type of equipment (e.g., hoppers, engine containers, Conex containers, tri-wall containers, drums, boxes, pallets, racks) should be on hand in sufficient quantity to facilitate scrap storage and processing.

Figure C3.F8. "Just Around the Corner" from the Scrap Yard Shown in Figure C3.F7., the New Scrap Yard Has Improved Surfacing, Concrete Pads and Heavy Duty Wood Bins, Resulting in a Safer and More Desirable Working Environment.

Figure C3.F9. Crawler-Mounted, Hydraulic Knuckle-Boom Crane, with Magnet

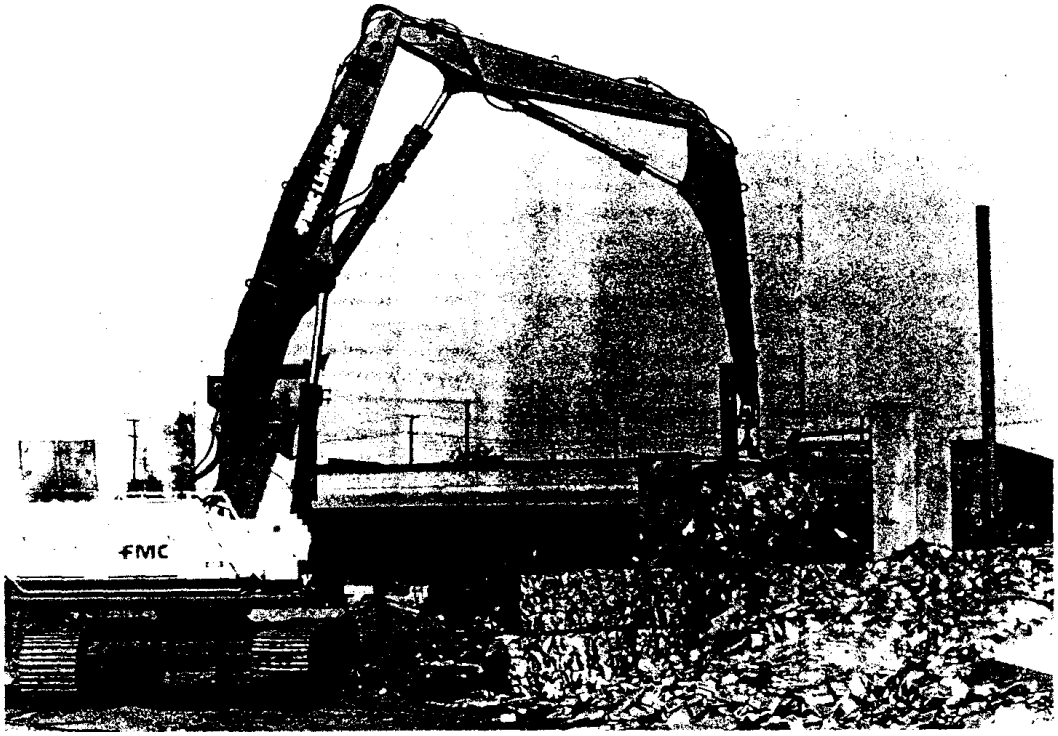


Figure C3.F10. Truck-Mounted Crane, without Attachments

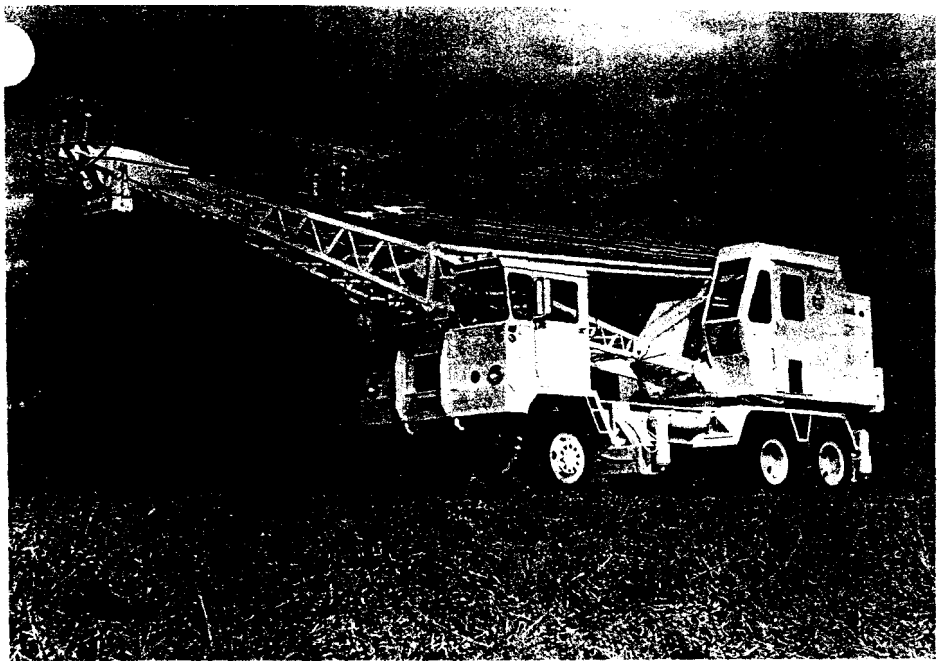


Figure C3.F11. Hydraulically Operated Rotary-Grapple Attacment

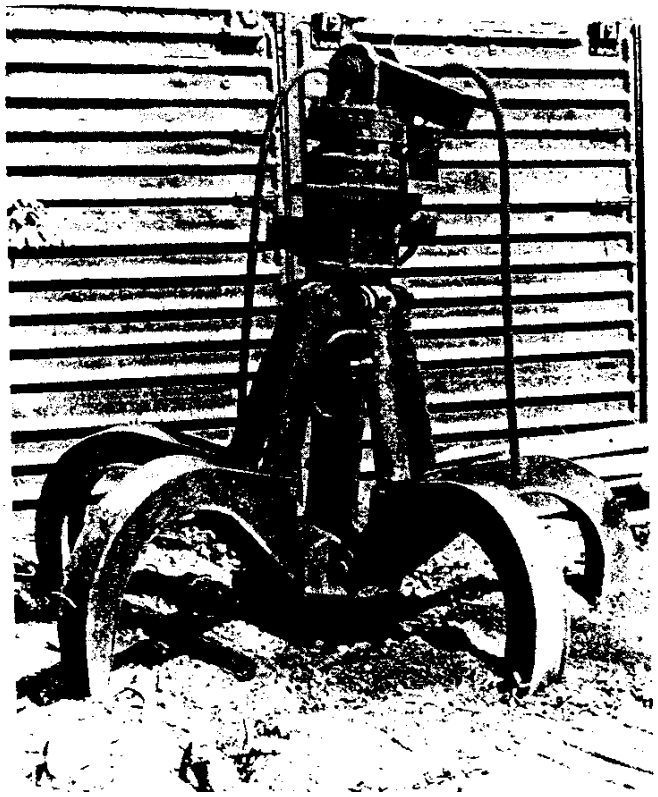


Figure C3.F12. Rail-Mounted Crane, with Clamshell Attachment.

Figure C3.F13. Forklift with Rotary-Head Attachment

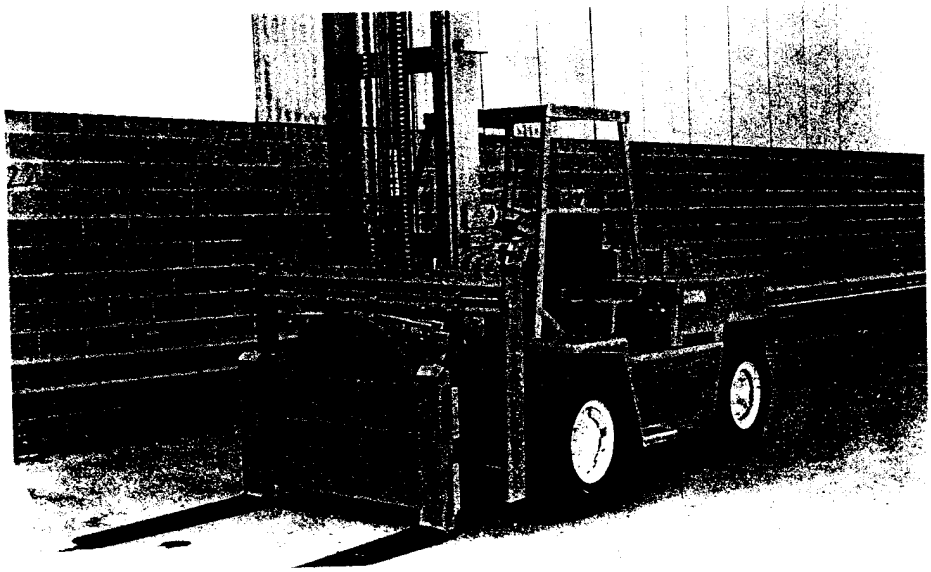


Figure C3.F14. Another Rotary-Head Model, This One Is Equipped with a Safety Sheild

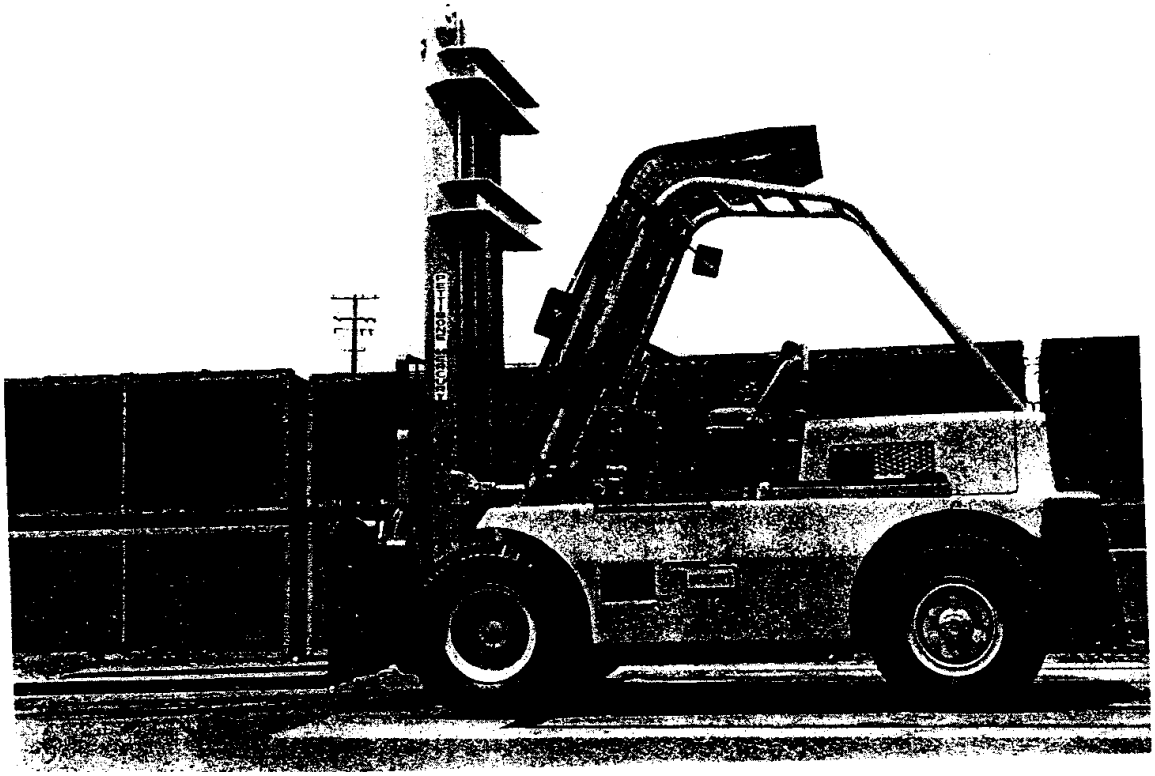


Figure C3.F15. With the Addition of Platens on the Forks, This Rotary Head Is Used to Dump Barrels

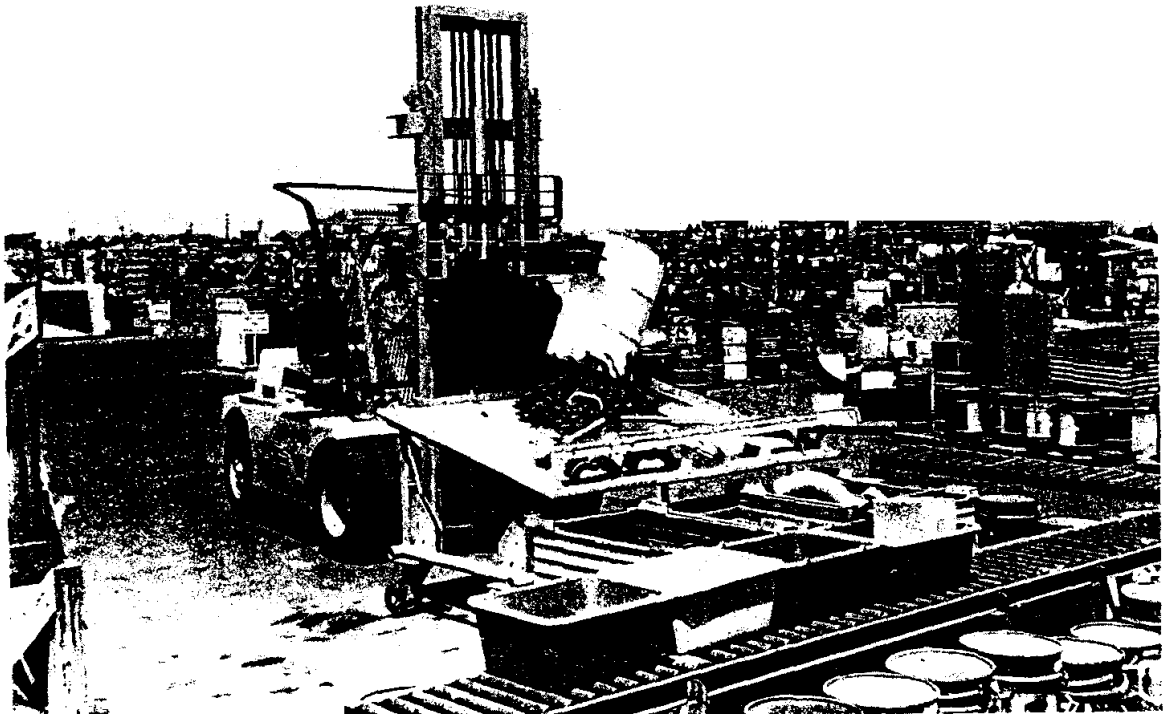


Figure C3.F16. Paper and Textile Baler

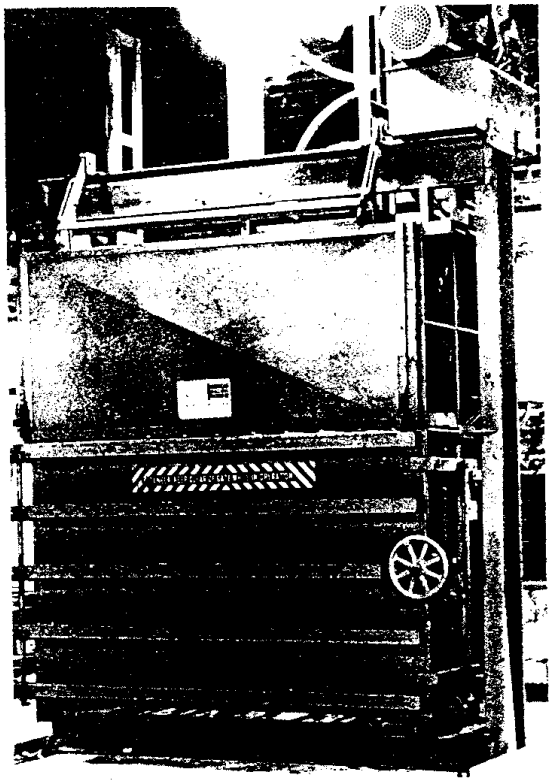


Figure C3.F17. Metal Baler

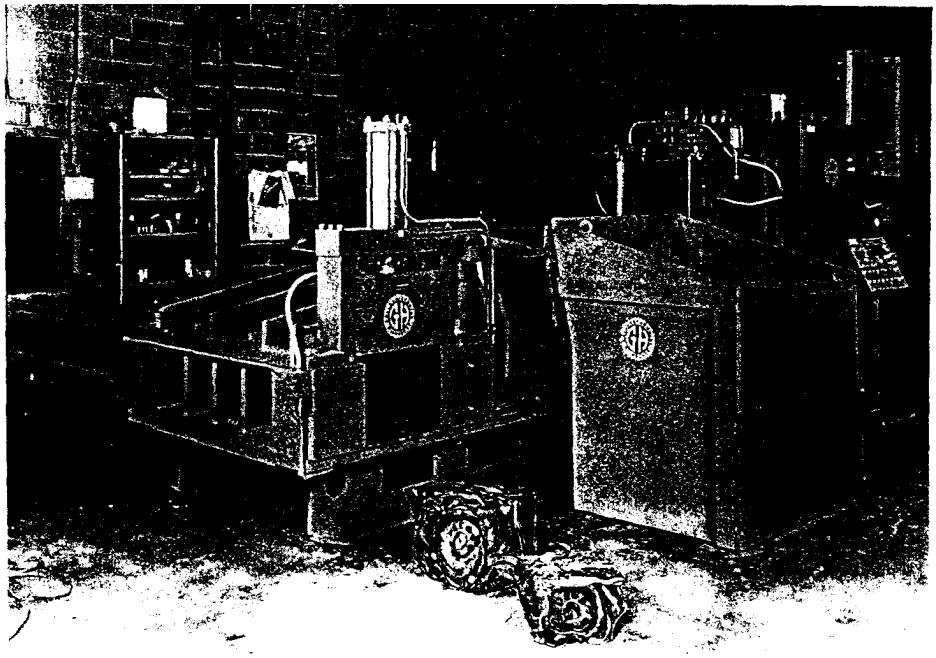


Figure C3.F18. Metal Shears. Note Plexiglass Safety Sheild in Front of Operator

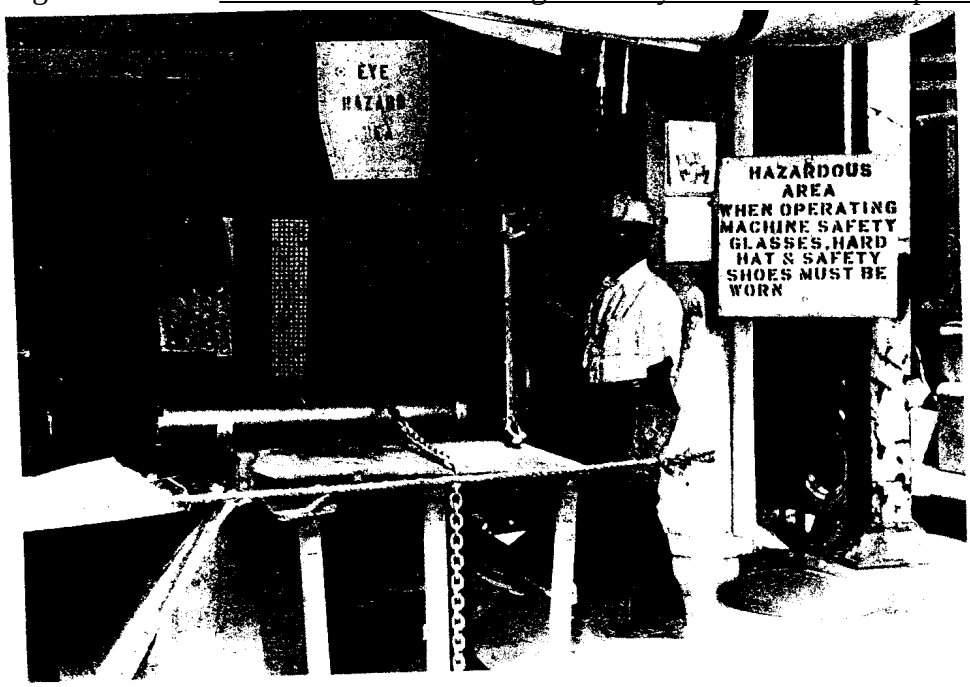


Figure C3.F19. Storage Devices Such as These Engine Containers Serve to Minimize Manual Handling of Scrap Properly

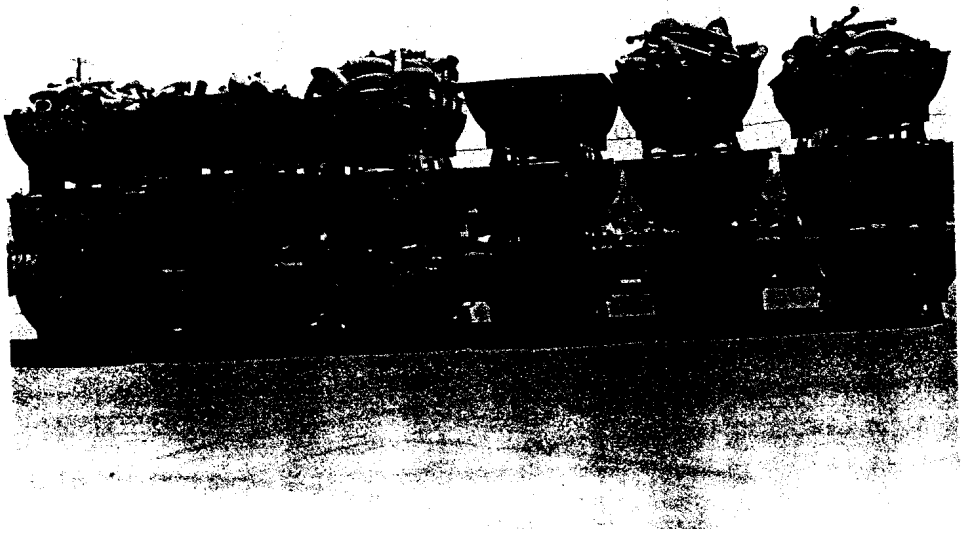


Figure C3.F20. Self-Dumping Hoppers Are Labor-Saving Storage Aids

Figure C3.F21. A Variety of Containers Can Be Used to Store, Handle, and Display Scrap

Figure C3.F22. Box or Cage Pallets Are Unsuitable for Storage and Display of Small, Lightweight Scrap and Can Be Readily Emptied By Rotary-Head Forklifts

C3.3.5. Specialized Processing Equipment

C3.3.5.1. The commercial scrap recycling industry has invested millions of dollars in modern scrap processing equipment in an effort to improve the productivity of their scrap processing operations and, by making optimum use of this equipment, they have been able to minimize manual handling of scrap and to package it in such a way as to effect a significant increase in the cost effectiveness of subsequent phases of the private sector's recycling effort. The U.S. Bureau of Mines works closely with the private sector to promote optimum exploitation of promising new technological developments for recovering and recycling such metals as aluminum, copper, lead, zinc, super alloys, and precious metals. Included among relevant private or public sector research projects are evaluations of improved techniques for compaction and baling of scrap, shredding of scrap followed by screening, air classification, and magnetic, Eddy current, centrifugal, cryogenic flotation separation, electrolysis, incineration, smelting, pyrolysis, and various types of chemical processing. DoD scrap yard managers should consider using one or more of these techniques wherever they can be economically justified.

C3.3.5.2. DoD scrap yard managers should also consider using conveyor belt or drum-type magnetic separators (which the host activity may have available for use in conjunction with automatic feed and conveyor systems) to segregate ferrous

contaminants from brass shell casings; and they should be alert to exploit any waste to energy conservation projects that may become available at nearby DoD or civilian installations. The operators or owners of these projects may be interested in accepting or even buying used petroleum products, tires, and other combustible scrap for conversion into heat or power.

C3.4. SUMMARY

C3.4.1. Development and Planning. Before developing a new scrap yard facility, or modernizing an old facility, a comprehensive engineering study should be conducted to ensure that drainage, soil characteristics, access and other environmental factors are properly evaluated. For example, the scrap yard site should be fenced and landscaped to provide both a visual and security shield; and effective provisions for abatement of water, air and noise pollution should be engineered into the facility design.

C3.4.2. Layout. The scrap yard layout should provide for a continuous and efficient flow of scrap; and internal movement of scrap should be minimized by placing carefully selected processing equipment adjacent to the appropriate storage areas and by locating storage areas adjacent to loading stations (e.g., installing ferrous scrap bins adjacent to rail spur).

C3.4.3. Work Flow. Manual handling of scrap should be minimized to the extent economically justified, by imaginative use of modern labor saving equipment.

C4. CHAPTER 4

SEGREGATION AND IDENTIFICATION

C4.l. SEGREGATION AT THE SOURCE

C4.1.1. The most critical rule in the initial handling of scrap is to ensure source segregation at all locations where scrap is initially generated. Chapter 5 specifies the Scrap Classification List (SCL) codes and industry standards to be used as guides in identifying each type of scrap as it is segregated. Chapter 6 provides further guidance relative to identification of precious metal-bearing scrap. Source segregation is particularly applicable to production shops, machine shops and repair shops where several different scrap materials are being generated since it is very difficult, and often not feasible, to segregate scrap after arrival at a scrap yard. As indicated in Chapter 2,top-priority attention should be given to nonferrous scrap (including precious metal-bearing scrap) and to other metallic scrap containing high-value alloys.

C4.1.2. Generations of metal clippings and trimmings, shearings, and skeleton stampings should first be considered for possible reuse. For example, scrap skeletons produced during punching or stamping operations can sometimes be used to produce smaller stampings. When baling skeletons, the longer pieces are useful as wrappers to form the outside of the bundle.

C4.1.3. If scrap containing different metal alloys is kept separate and free from contamination, it can be economically melted into ingots of the same composition as the original material from which it was generated. But if scrap containing different metal alloys become commingled or contaminated, it is likely to end up in a smelter where its valuable alloy content may be lost. If there is too much contamination, it may not be feasible to recycle the high-value metals contained in such scrap.

C4.1.4. One of the best methods of segregation at the source is to place properly marked containers where each type of scrap can be collected without further handling as it is generated. If this is not practicable, containers should be located in such a way as to facilitate direct transfer of segregated floor sweepings. Whenever there is a change in the material being worked, the machine should be thoroughly cleaned and properly marked new containers should replace the old ones. As containers are filled and delivered to the scrap yard, they will be emptied into large hoppers or into bins containing similar materials. It is essential that all containers, hoppers, and bins be kept free from contamination and that the identity of each type of scrap generated is maintained throughout the entire scrap disposal process.

C4.1.5. A good method of marking containers, hoppers, and bins is to paint a band of distinctive color around them to identify the specific type of scrap to be placed therein-without any commingling or contamination with other property. More specific identification of the kind of scrap contained therein can be accomplished by fastening a color-coded tag marked with the appropriate alloy type, specification or code number; and machines generating this scrap should be marked with identical tags.

C4.1.6. Full cooperation in source segregation must be obtained from everyone concerned with scrap handling. Otherwise, scrap containers are likely to be used as a place to dump the remains of lunch boxes, bottle caps, empty cigarette packages, and other contaminants. To minimize such contamination, supervisors should conduct a continuing educational campaign to stress the critical importance of scrap segregation; and they should ensure that separate refuse containers are provided in a nearby location to minimize the temptation to misuse scrap containers.

C4.2. IDENTIFICATION OF METALLIC SCRAP

C4.2.1. Visual Identification. This method is used to identify metallic scrap in terms of color, use, and weight. Most metallic scrap turned in to DoD scrap yards can be classified into four color categories: red, pink, yellow and silver gray. It can be further classified by weight in terms of heavyweight, lightweight, or medium-weight. If information is readily available as to the use made of the items from which the scrap was derived, further identification tests may not be necessary.

C4.2.2. Magnetic Testing. Magnetic testing makes use of magnets to determine whether or not the scrap contains ferromagnetic materials (i.e., iron, nickel, and cobalt) or nonmagnetic materials. Iron-base alloys (i.e., cast iron, plain carbon, and low-alloy steels) are most likely to be magnetic, although a few nickel alloys are also magnetic. A small permanent magnet can be used for this purpose. However, it is important to note that magnetic testing can serve only as an initial approximate classification of alloys. It should never be used as a conclusive test (except to separate two alloys of known composition, one being magnetic and the other nonmagnetic).

C4.2.3. Spark Testing

C4.2.3.1. Spark testing makes use of the fact that some metals, in a finely divided state, will oxidize rapidly when heated to a high enough temperature. When such metals are ground by a high-speed grinding wheel, the fine particles torn loose are oxidized and raised to an incandescent temperature through the heat of friction on the wheel.

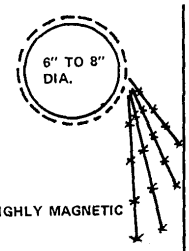
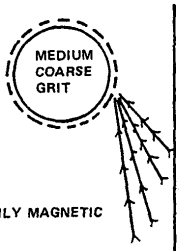
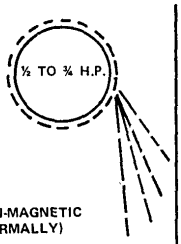
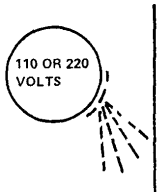
C4.2.3.2. Among the commercially important alloys, those with an iron, nickel, monel or titanium base give characteristic sparks. Certain elements used as alloying agents in steel impart characteristic and recognizable variations in the sparks produced by basic carbon steel. (See Table C4.T1.)

C4.2.3.3. Proficiency in spark testing requires practice and reproducibility in sparking results. Lighting conditions should be approximately the same each time when sparks are being examined against a dark background. Care should be taken to apply the same amount of pressure over the same sparking area in each test. Only with such reproducibility, or by comparison with sparks produced from samples with known compositions, can spark testing be depended on for identification.

C4.2.3.4. Spark tests are conducted on a high-speed portable or bench power rinder. When a portable grinder is used, the wheel of the grinder is usually touched to the sample so that sparks fly off horizontally. Use of safety glasses is mandatory to ensure eye protection. When a bench grinder is used, checks should be made to ensure that the grinder tongue guard and tool rest are adjusted properly. The preferred method is to hold the test sample and touch it to the grinding wheel (see Figure C4.F1.). The surface speed should be at least 8,000 rpm. However, a stationary grinder or bench grinder turning a medium-coarse abrasive wheel at 3,400 to 3,600 rpm is satisfactory if care is taken to exert the same relative pressure against each sample. Grinding wheel composition is most important and must be appropriate to the type of metal being spark tested. For normal carbon steel alloys used in construction, carborundum (usually described as aloxite resinold, A36-QB4-3 x 3/8 x 3/8) should be used. However, in spark testing of tool steel or stainless steel it may be best to make use of other types of grinding wheels and the alloy producer should be consulted for the most apprpriate wheel designation.

C4.2.3.5. To prevent possible contamination of the spark from particles retained in the wheel during previous spark tests, grinding wheels should be cleaned frequently.

Table C4.T1. Spark Testing Chart
(Copper Free Metals)

NORMAL CARBON STEEL	400 SERIES CHROME STAINLESS STEEL	300 SERIES STAINLESS STEEL, 18-8 ALLOY	310 SERIES STAINLESS STEEL, 25-20 ALLOY	NICKEL AND COBALT HIGH TEMPERATURE ALLOYS
				
HIGHLY MAGNETIC	HIGHLY MAGNETIC	NON-MAGNETIC (NORMALLY)	NON-MAGNETIC	NON-MAGNETIC
HEAVY DENSE SPARKS 18" TO 24" LONG WHICH TRAVEL COMPLETELY AROUND THE GRINDING WHEEL.	SPARKS ARE NOT AS HEAVY OR AS DENSE AS THOSE OF NORMAL CARBON STEEL.	SPARKS ARE NOT AS HEAVY OR AS DENSE AS THOSE OF NORMAL CARBON STEEL.	THE SPARK STREAM IS THIN AND FROM 4" TO 6" LONG.	THE SPARK STREAM IS THIN AND ABOUT 2" LONG.
SPARKS ARE WHITE TO STRAW COLORED WITH STAR BURSTS AND SHELL BURSTS THROUGHOUT.	SPARKS ARE 14" TO 18" LONG, TRAVEL COMPLETELY AROUND THE GRINDING WHEEL AND ARE ORANGE TO STRAW COLORED ENDING WITH THE APPEARANCE OF A SPLIT TONGUE.	SPARKS ARE 12" TO 18" LONG, TRAVEL COMPLETELY AROUND THE GRINDING WHEEL AND ARE ORANGE TO STRAW COLORED ENDING IN A STRAIGHT LINE WITH FEW, IF ANY, STAR BURSTS OR SHELL BURSTS.	SPARKS ARE ORANGE TO RED IN COLOR, DO NOT TRAVEL AROUND THE GRINDING WHEEL WITH NO STAR BURSTS OR SHELL BURSTS.	SPARKS ARE DARK RED IN COLOR, DO NOT TRAVEL AROUND THE GRINDING WHEEL WITH NO STAR BURSTS OR SHELL BURSTS.

NOTE: THE SHORTER AND REDDER THE SPARK THE MORE NICKEL AND/OR COBALT IN THE ALLOY.
THE LESS WHEEL HUGGING OF SPARKS THE MORE NICKEL AND/OR COBALT IN THE ALLOY.

Figure C4.F1. Spark Testing Metal On A Grinding Wheel.

C4.2.4. Chemical Spot Testing

C4.2.4.1. Chemical spot tests used for sorting or final identification of materials show attack or lack of attack by specific chemicals to determine the presence or absence of specific alloying elements. Spot tests are based on the formation of characteristic colors or precipitates of the unknown elements when those elements react with various test chemicals. Such tests may also be carried out electrographically on filter paper or on spot plates. (See Figure C4.F2.)

C4.2.4.2. Electrographic spot tests make use of a metal "sandwich" consisting of a piece of aluminum or platinum on the outside and two pieces of filter paper moistened with an appropriate solution on each side of the sample in the middle of the sandwich. Current from two dry cell batteries is then passed through the filter paper for a specified length of time with the unknown metal serving as the anode, and the inert metal on the outside of the sample serving as the cathode. The filter paper will thus be impregnated with dissolved matter from the sample. The filter paper is then removed from the sandwich and treated with suitable reagents to bring out the desired color reactions. Filter paper on half to one inch square is large enough for this work.

C4.2.4.3. A more common type of spot test involves placing one or two drops of an acid or alkali on the surface of the sample, transferring the drops to a reagent-impregnated filter paper, or transferring it to a spot plate.

C4.2.4.4. Capillary tubes are usually best for placing drops on test samples, since minimum quantities of the reagent used will give the best results. However, it may sometimes be better to conduct spot testing in test tubes.

C4.2.4.5. It is important to remember that, except under rigid laboratory control, spot tests are no more than qualitative tests. If more precise tests are needed, scrap yard personnel should seek professional assistance from the nearest available laboratory facility.

Figure C4.F2. Chemical Spot Testing

C4.3. SIMPLIFIED METAL TESTING AND SORTING PROCEDURES

C4.3.1. General. Scrap yard personnel can proceed step by step, as indicated below, to determine the probable composition of metallic scrap. (See Figure C4.F3.)

C4.3.2. Visual Identification

C4.3.2.1. Color Criteria:

C4.3.2.1.1. Red or reddish color indicates copper.

C4.3.2.1.2. Light brown or tan color indicates 90/10 cupro-nickel.

C4.3.2.1.3. Dark yellow color indicates bronze.

C4.3.2.1.4. Light yellow color indicates brass.

C4.3.2.1.5. Bluish or dark gray color indicates zinc, kirksite, or lead.

C4.3.2.1.6. White or light gray color indicates aluminum, or magnesium.

C4.3.2.2. Weight Criteria:

C4.3.2.2.1. Heavyweight samples include platinum, tungsten, gold, mercury, lead, silver, or molybdenum.

C4.3.2.2.2. Lightweight samples include magnesium, aluminum, or titanium.

C4.3.2.2.3. Medium-weight samples include most other metals.

C4.3.3. Magnetic Testing

C4.3.3.1. Strongly magnetic samples include steel, iron, nickel, cobalt, and 400 series chromium stainless steels.

C4.3.3.2. Slightly magnetic samples include monel (except "K"monel) and occasionally 90/10 cupro-nickel, manganese bronze, aluminum bronze, and silicon bronze. Also, ordinary stainless steels of the 300 series, which are normally nonmagnetic, may develop slight magnetic properties after having been subjected to extreme heat or pressure for prolonged periods.

C4.3.3.3. Nonmagnetic samples include nearly all other metals, including "K" monel.

C4.3.4. Spark Testing. Different metals and alloy combinations impart characteristic sparks that aid in the identification of the metals. Since the sparking characteristics of many different metals are so similar, other means must usually be employed to verify the identity of test samples. The principal criteria that should be considered when observing a spark test are:

C4.3.4.1. Length of carrier lines.

C4.3.4.2. Color of sparks.

C4.3.4.3. Density of carbon star bursts (none, few, many).

Figure C4.F3. Metal Identification

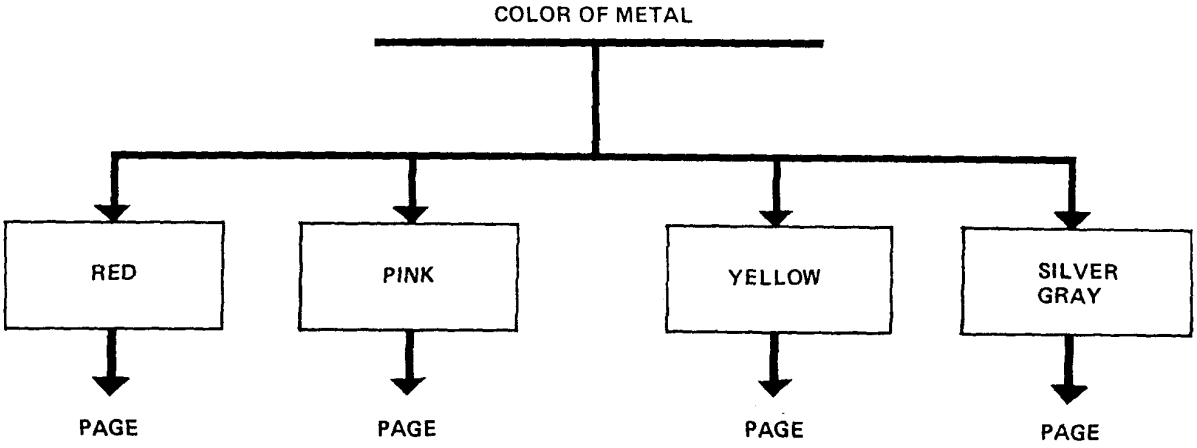


Figure C4.F3. Metal Identification, continued

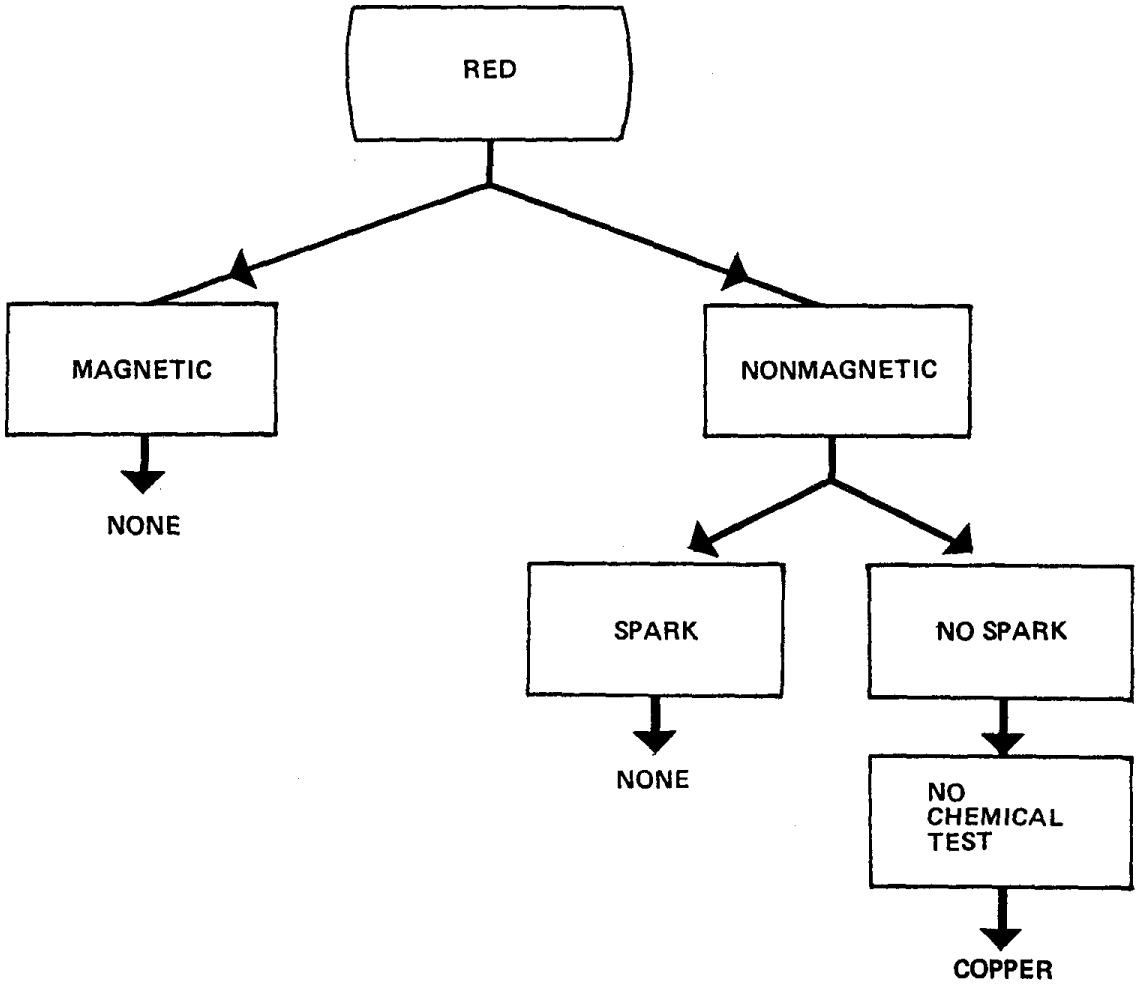


Figure C4.F3 Metal Identification, continued

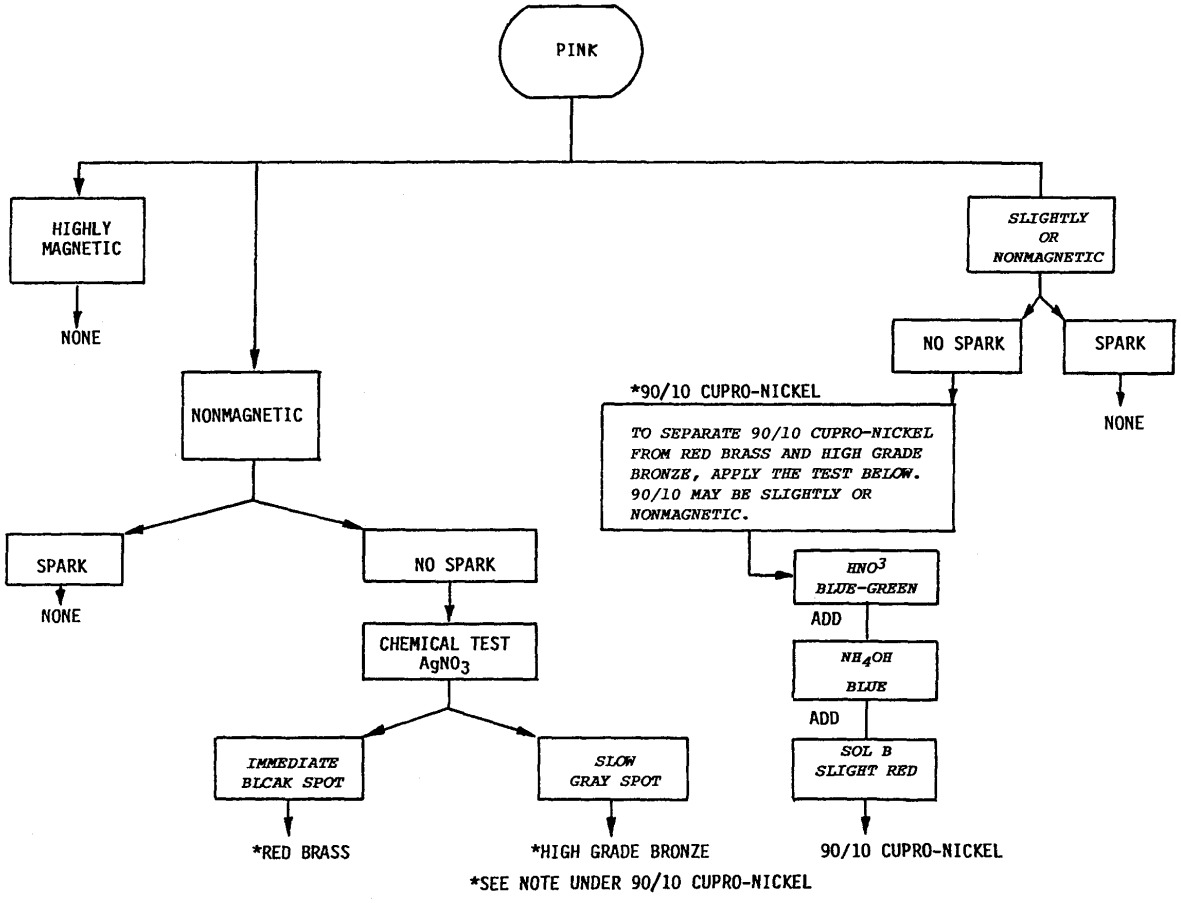


Figure C4.F3. Metal Identification, continued

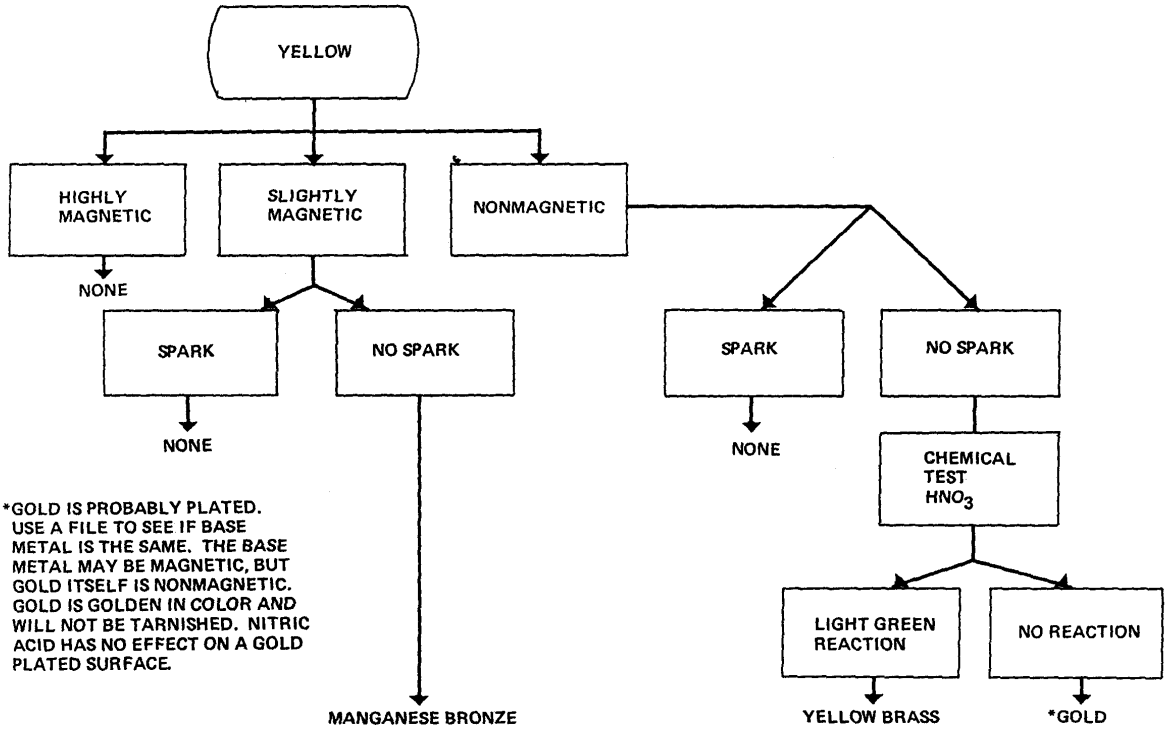
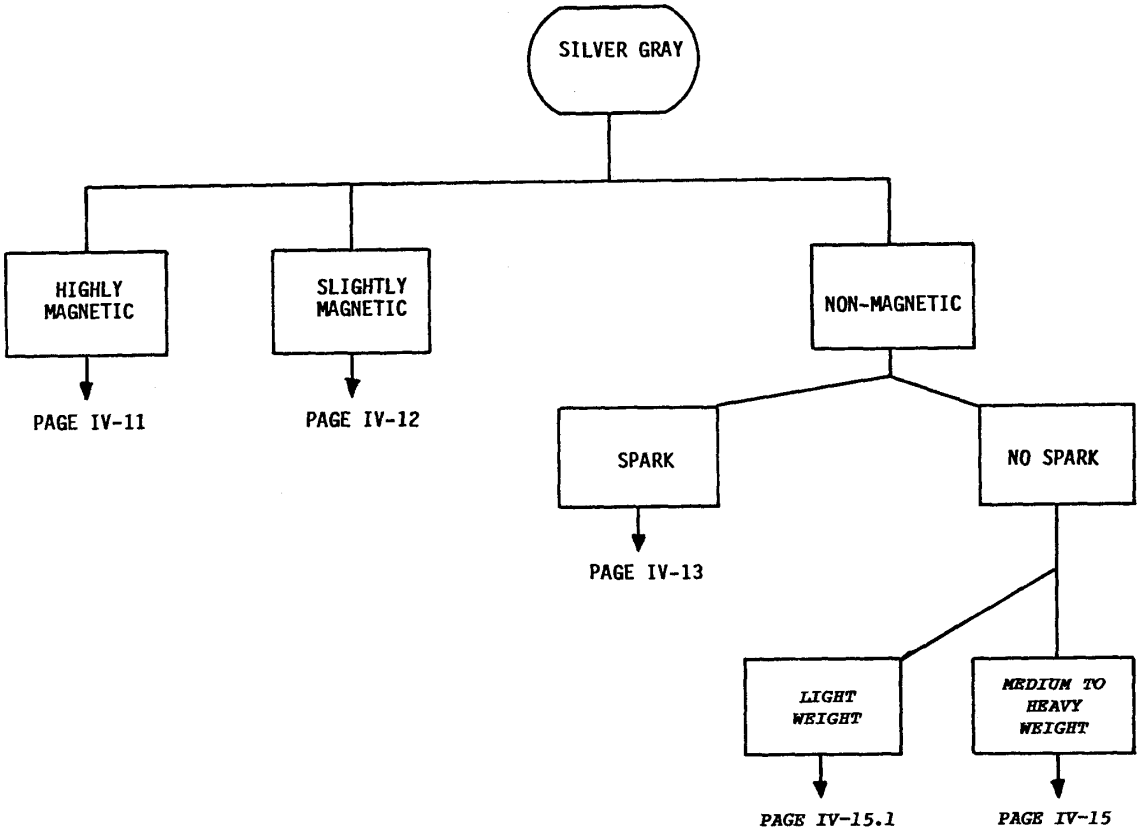


Figure C4.F3. Metal Identification, continued



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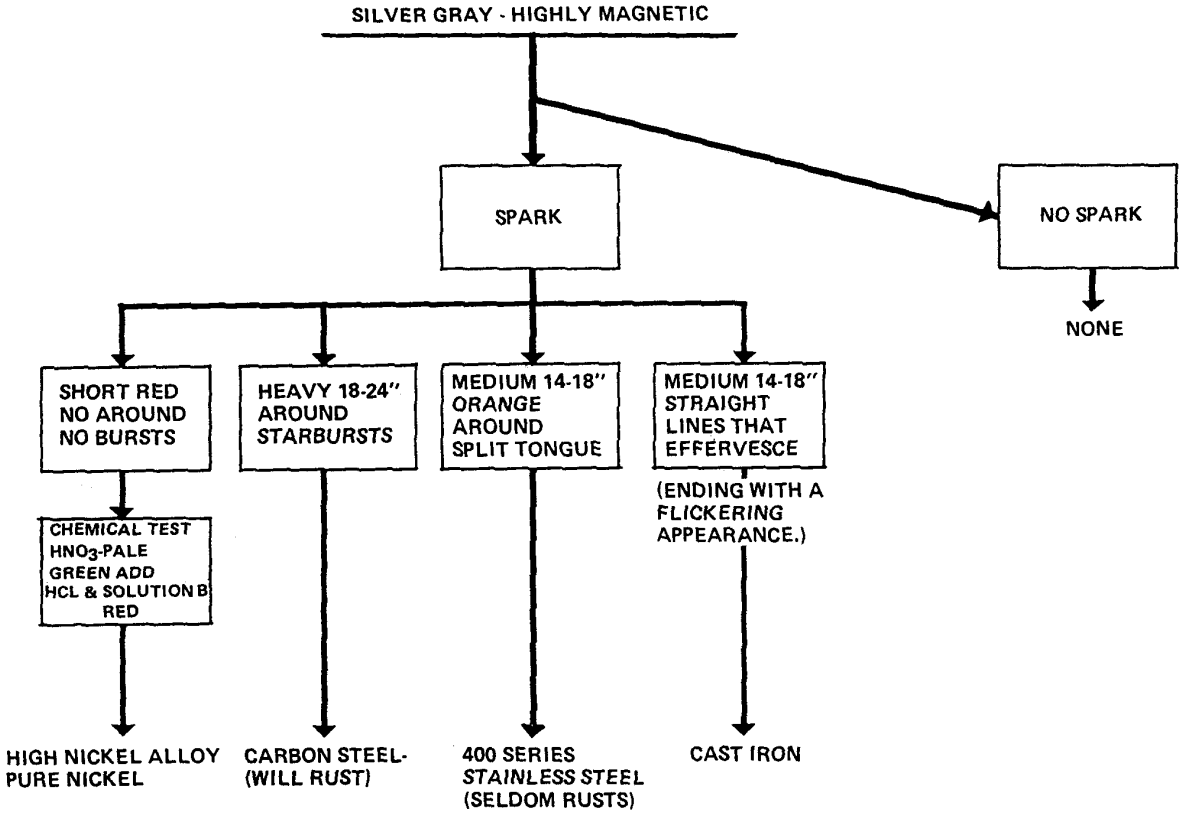

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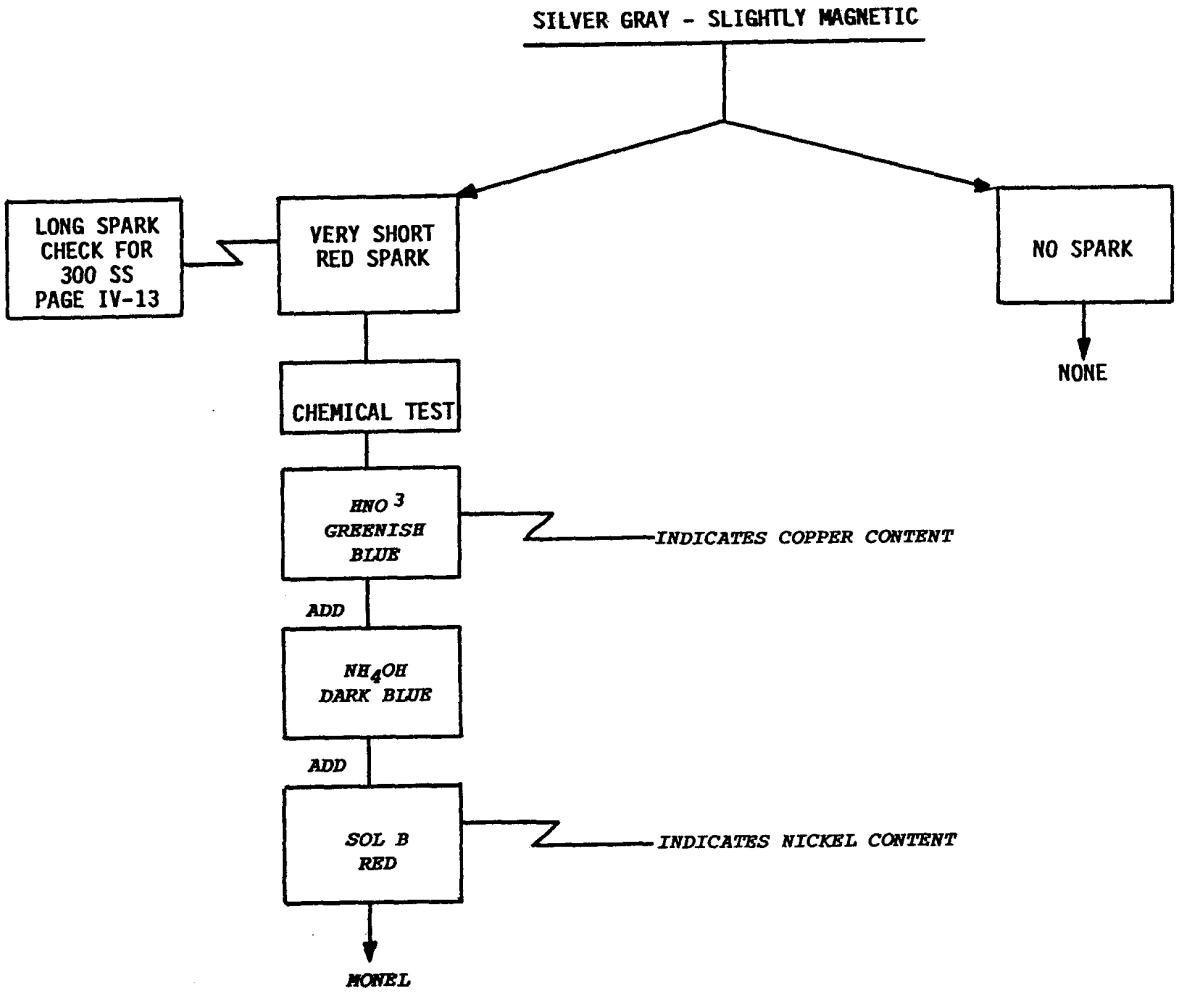


Figure C4.F3. Metal Identification, continued

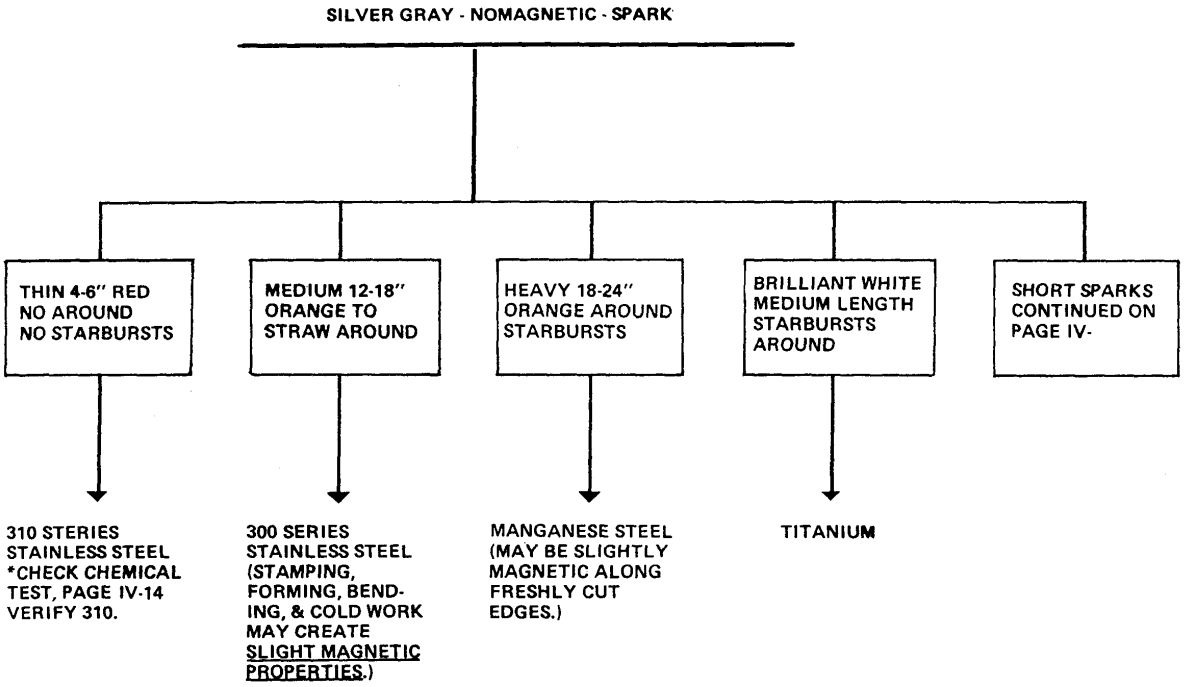


Figure C4.F3. Metal Identification, continued

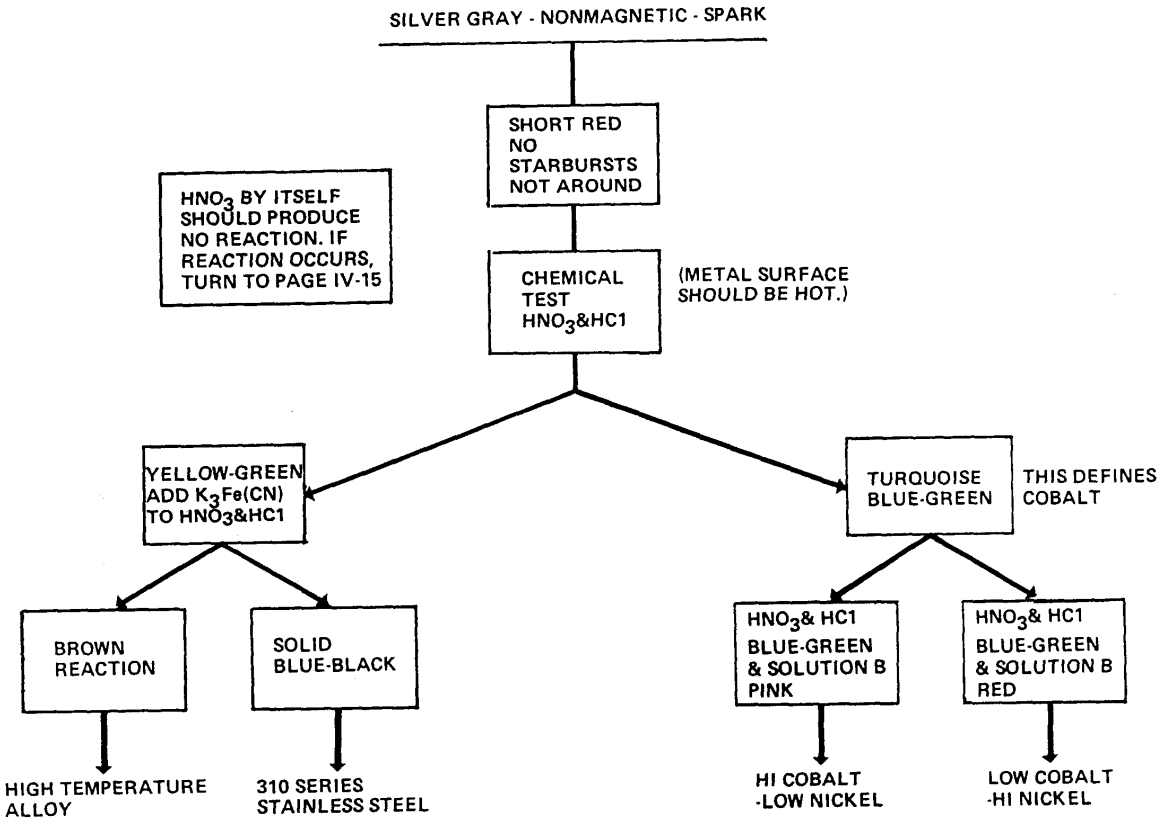
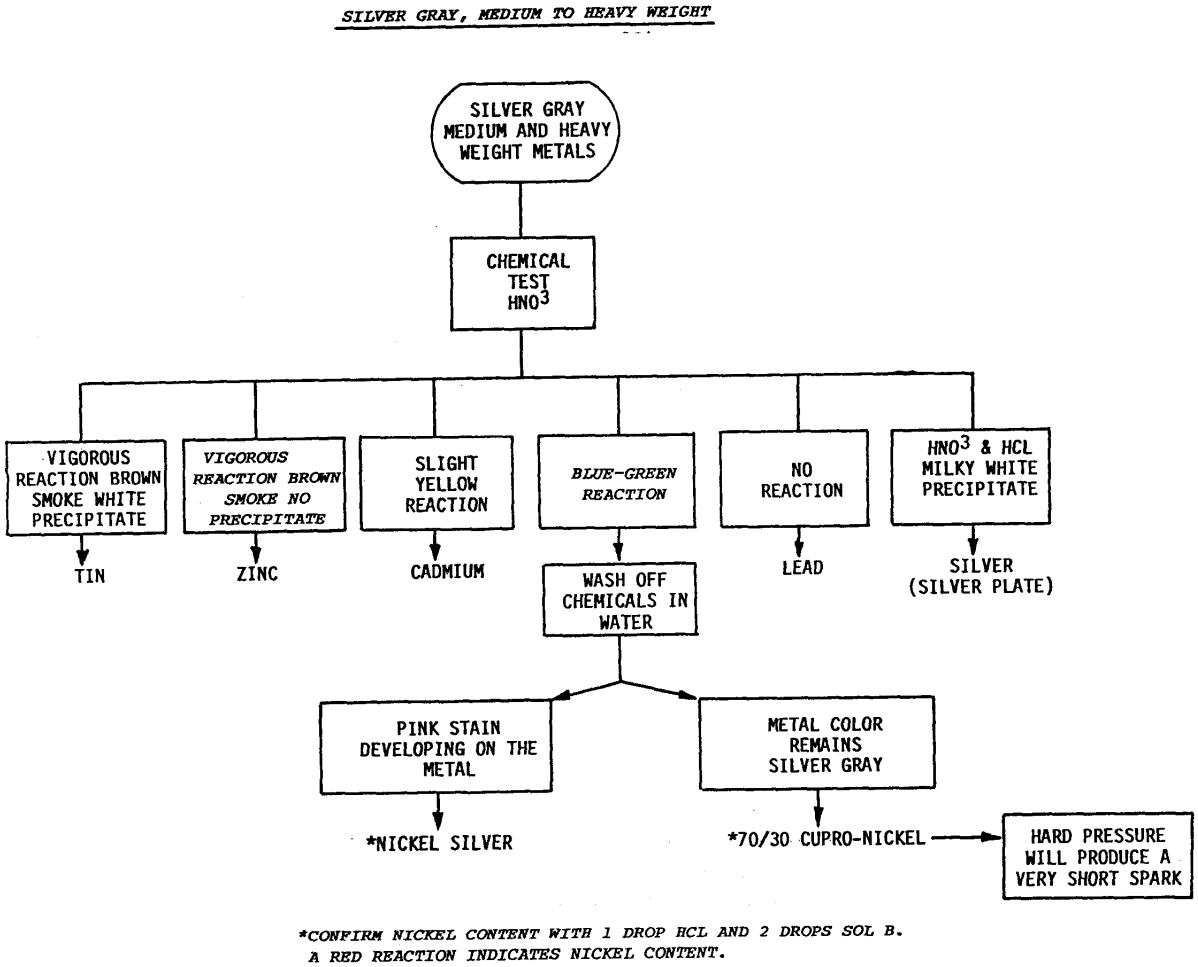


Figure C4.F3. Metal Identification, continued



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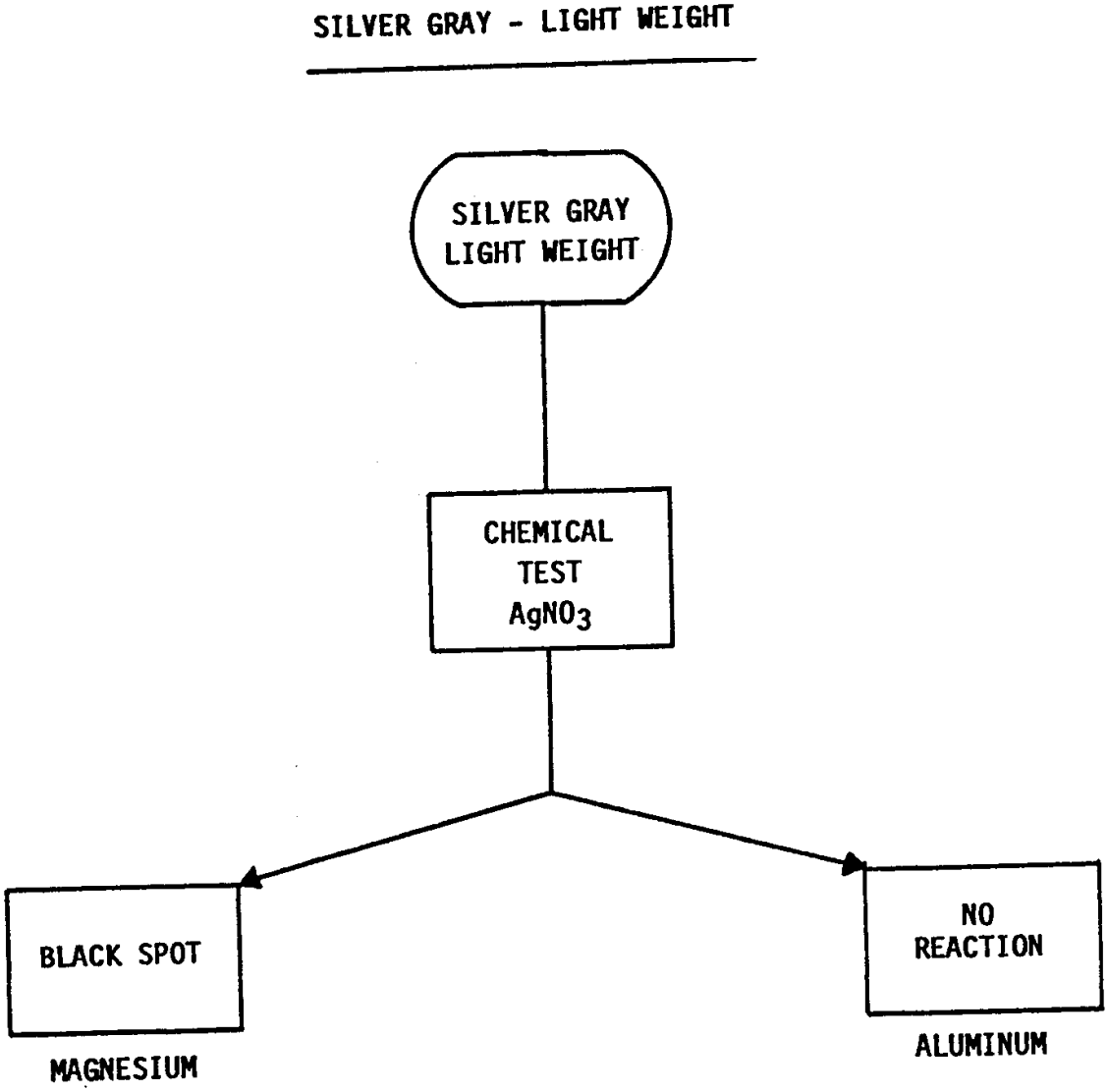
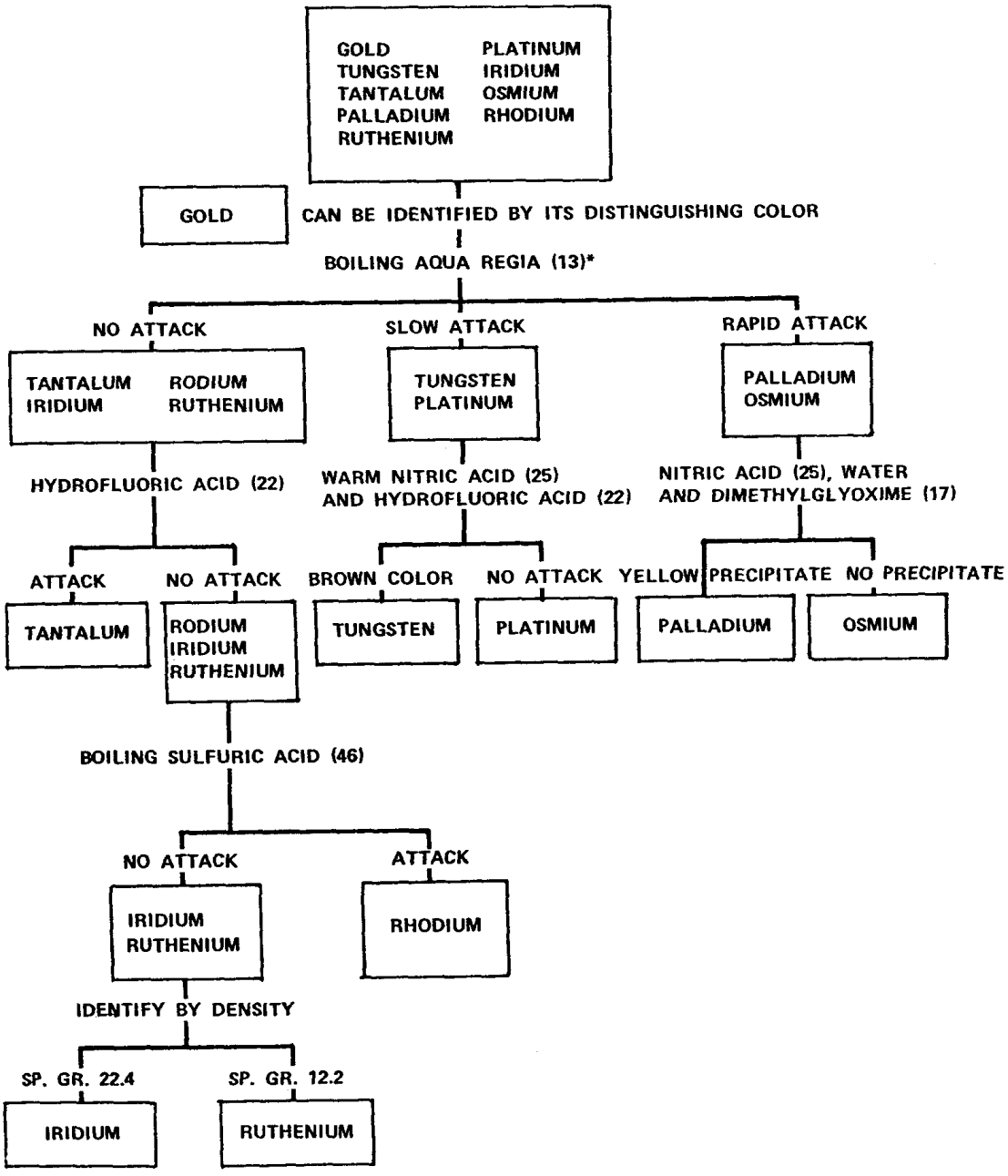


Figure C4.F4. Chart 1.
Identification of Very Heavy Metals
(Specific Gravity12 to 22)



*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2

C4.4. PROCEDURE FOR CHART 1

C4.4.1. VERY HEAVY METALS, specific gravity 12 to 22--gold, tungsten, tantalum, palladium, platinum, and platinum-group metals (osmium, iridium, rhodium, and ruthenium). Consult Figure C4.F4., Chart 1.

C4.4.1.1. GOLD is easy to spot; other metals are white or grayish white.

C4.4.1.2. Immerse in boiling aqua regia (13)*; observe in 2 minutes.

C4.4.1.2.1. No attack indicates tantalum, iridium, rhodium, or ruthenium. Add hydrofluoric acid (22).

C4.4.1.2.1.1. An attack indentifies *Tantalurm*.

C4.4.1.2.1.2. No attack indicates iridium, rhodium, or ruthenium. Immerse in boiling'sulfuric acid (46) and observe at the end of 2 minutes.

C4.4.1.2.1.2.1. An attack identifies *Rhodium*.

C4.4.1.2.1.2.2. No attack indicates iridium or ruthenium. Identify by density.

C4.4.1.2.1.2.2.1. *Ruthenium, sp. gr. 12.2.*.

C4.4.1.2.1.2.2.2. *Iridium, sp. gr. 22.4.*.

C4.4.1.2.2. A slow attack indicates platinum or tungsten. Immerse in nitric acid (25) and hydrofluoric acid (22), warm, and observe at the end of 2 minutes.

C4.4.1.2.2.1. An attack and brown color identifies *Tungsten*.

C4.4.1.2.2.2. No attack identifies *Platinum*.

C4.4.1.2.3. A rapid attack indicates osmium or palladium. Immerse in hot nitric acid (25), dilute with water, and add dimethylglyoxime (17).

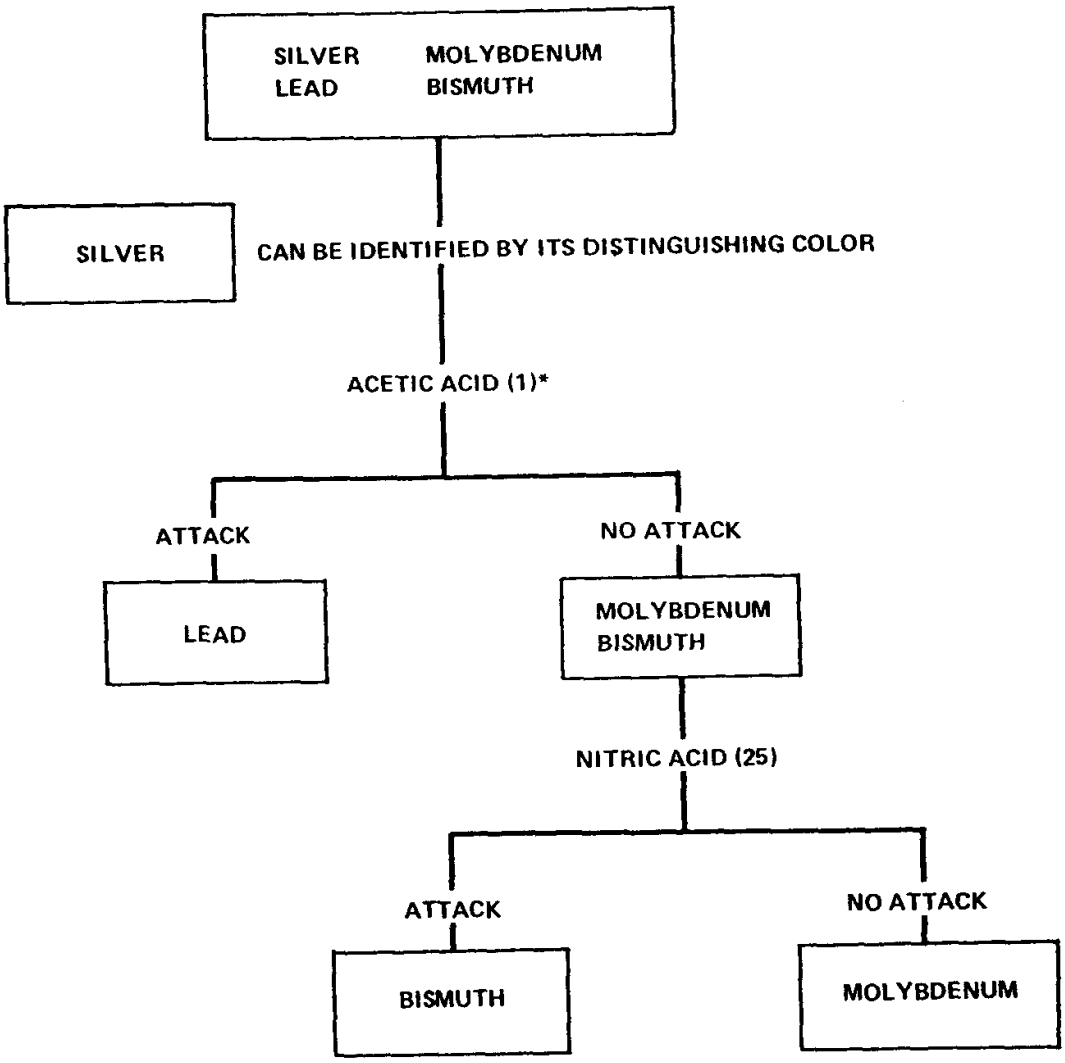
C4.4.1.2.3.1. A yellow precipitate identifies *Palladium*.

C4.4.1.2.3.2. Attack, but no precipitate identifies *Osmium*.

_____

* The figure in parentheses refers to the reagent listed in Table C4.T2.

Figure C4.F5. Chart 2.
Identification of Heavy Metals
(Specific Gravity 9.8 to 11.3)



*THE FIGURE IN PARENTHESE REFERS TO THE REAGENT LISTED IN TABLE IV-2

C4.5. PROCEDURE FOR CHART 2

C4.5.1. HEAVY METALS, specific gravity 9.8 to 11.3--lead, silver, molybdenum, and bismuth. Consult Chart 2.

C4.5.1.1. *Silver* can be identified by its distinguishing color; the other metals are white or grayish-white.

C4.5.1.2. Add acetic acid (1) and observe at the end of 1 minute.

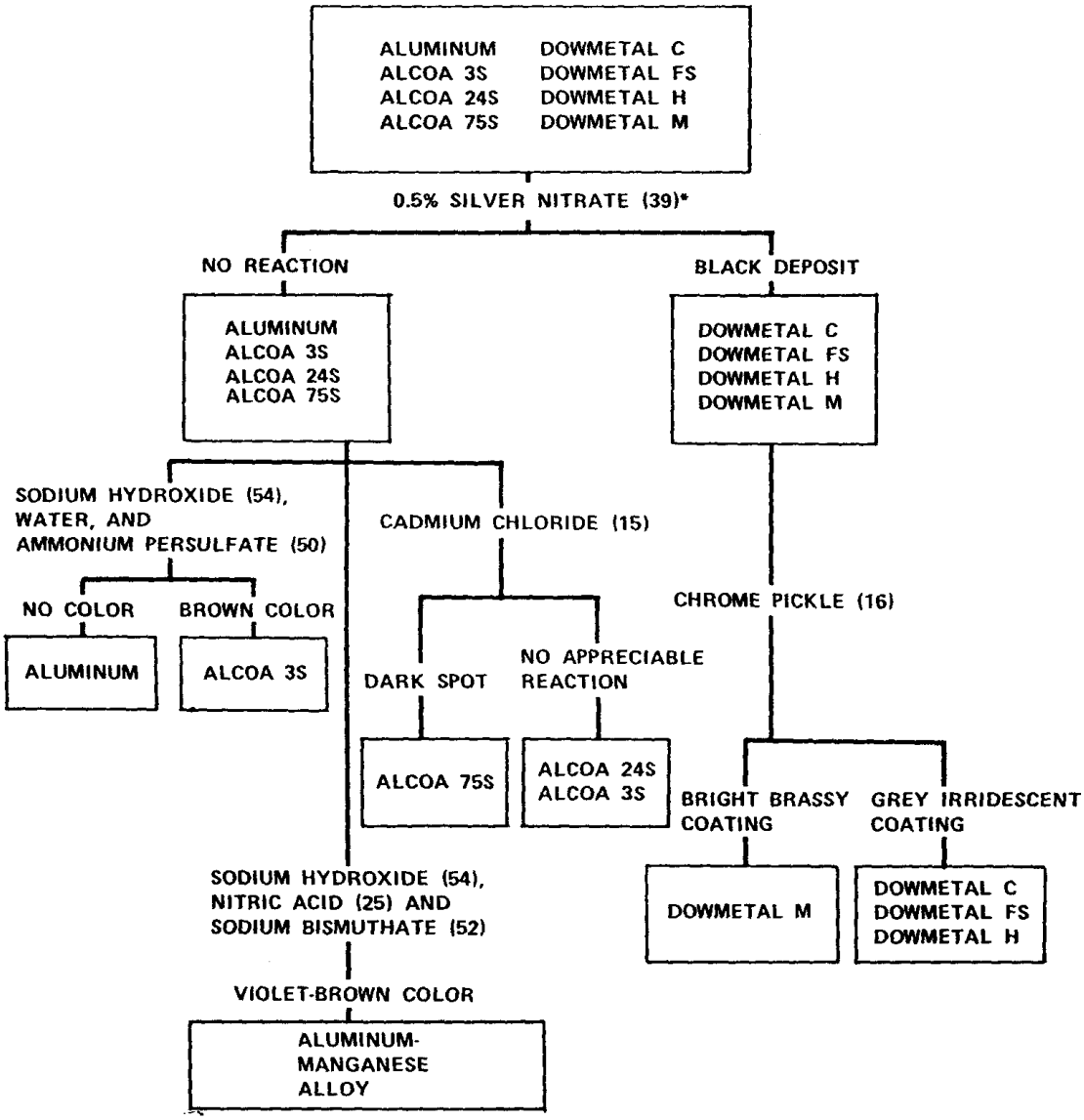
C4.5.1.2.1. An attack identifies *Lead*.

C4.5.1.2.2. No attack indicates molybdenum or bismuth. Add nitric acid (25) and observe at the end of 1 minute.

C4.5.1.2.2.1. An attack identifies *Bismuth*.

C4.5.1.2.2.2. No attack identifies *Molybdenum*.

Figure C4.F6. Chart 3.
Identification of Light Metals and Alloys
(Specific Gravity 1.5 to 3)



*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2

C4.6. PROCEDURE FOR CHART 3

C4.6.1. LIGHT METALS AND ALLOYS, specific gravity 1.5 to 3--aluminum, magnesium, and their light alloys. Consult chart 3.

C4.6.1.1. ALUMINUM

C4.6.1.1.1. Add a 0.5 percent solution of silver nitrate (39) and observe at the end of 1 minute.

C4.6.1.1.2. No action indicates aluminum or a high-aluminum alloy.

C4.6.1.1.3. Place 3 or 4 pellets of sodium hydroxide (54) on the specimen, add 3 or 4 drops of water, and allow to react for 1 minute. Then add a small crystal of ammonium persulfate (50).

C4.6.1.1.3.1. A brown color identifies *Alcoa* 3S.

C4.6.1.1.3.2. No color identifies *Alcoa* 2S (aluminum).

C4.6.1.1.4. Place 3 or 4 pellets of sodium hydroxide (54) on the specimen, add 3 or 4 drops of water, and allow to react for 1 minute. Then add nitric acid (25) to dissolve the precipitate and, finally, add a few crystals of sodium bismuthate (52). A violet-brown color identifies *Manganese* as the alloying element.

C4.6.1.1.5. Add cadmium chloride solution (15) and observe at the end of 2 minutes.

C4.6.1.1.5.1. A dark spot identifies *Alcoa* 75S, or other alloys containing zinc.

C4.6.1.1.5.2. No appreciable reaction identifies *Alcoa* 24S, *Alcoa* 3S, or other zinc-free alloys.

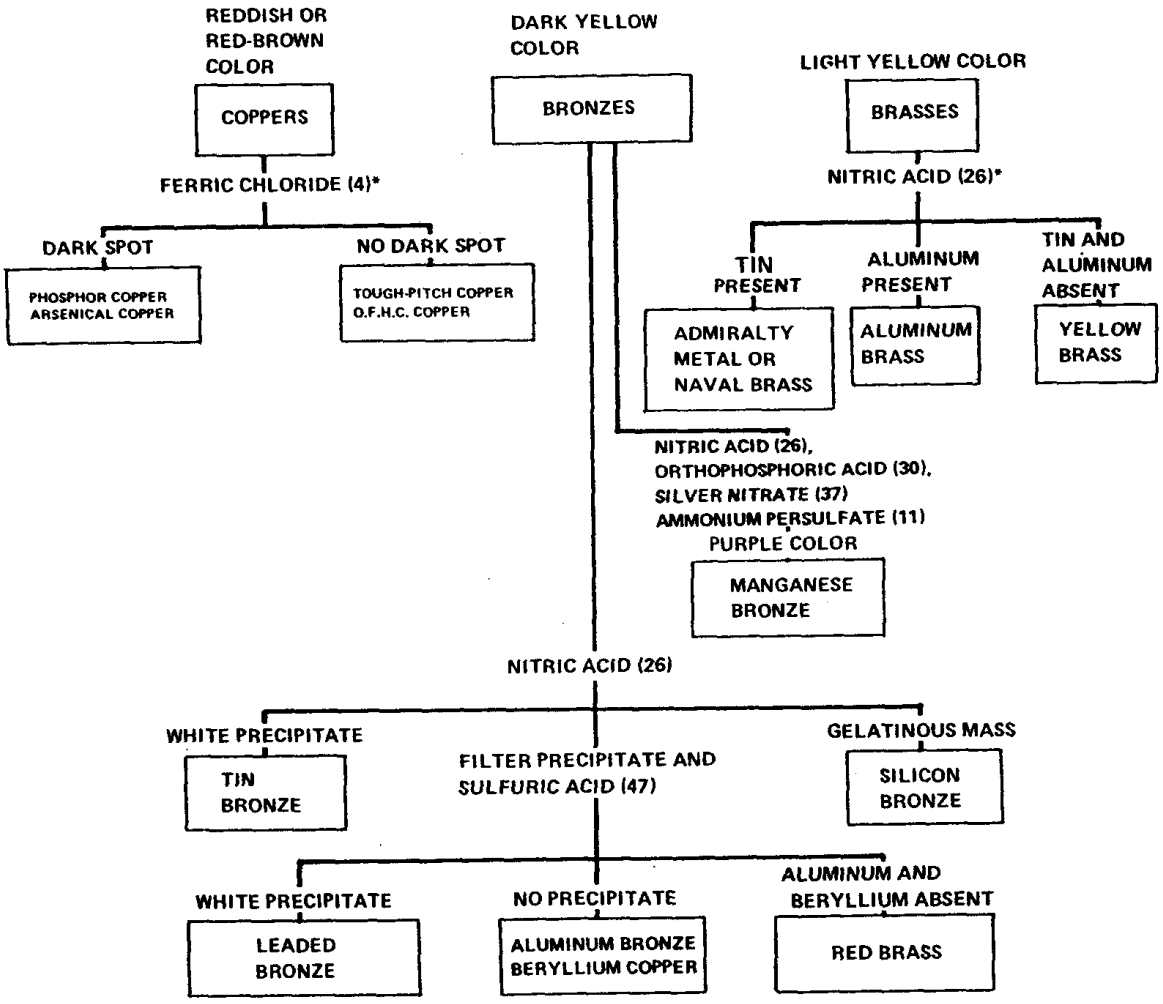
C4.6.2. MAGNESIUM

C4.6.2.1. A black deposit of metallic silver forming immediately indicates magnesium or a high-magnesium alloy. Immerse the metal in Chrome-Pickle (Dow No. 1 chemical treatment). *This test is recommended only when a freshly prepared solution is used and the operator is familiar with the colors of chemical treatment*.

C4.6.2.2. A very bright brassy coating on the metal identifies the aluminum-free magnesium alloys such as *Dowmetal* M.

C4.6.2.3. A grayish, iridescent coating on the metal identifies the aluminum-containing magnesium alloys such as *Dowmetal* C, H, FS, and others.

Figure C4.F7. Chart 4.
Identification of Copper and Copper Alloys*
(Specific Gravity 6 to 9)



*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED TABLE IV-2

C4.7. PROCEDURE FOR CHART 4

C4.7.1. AVERAGE DENSITY METALS AND ALLOYS (specific gravity 6 to 9)--steels, irons, stainless steels, stainless irons, copper alloys, nickel alloys, cadmium, tin, zinc, and antimony. Classify on the basis of color.

C4.7.1.1. Reddish or red-brown--Copper.

C4.7.1.2. Dark yellow--Bronzes.

C4.7.1.3. Light yellow--Brasses. Proceed according to color of material. Consult Figure C4.F7., Chart 4.

C4.7.1.4. White (magnetic and nonmagnetic)-Nickel, high-nickel alloys, copper-nickel alloys, nickel silvers, stainless steels, stainless irons, cadmium, tin, zinc and antimony.

C4.7.1.5. White, or brown, if oxidized (magnetic and nonmagnetic)--Consult Figures C4.F8. through C4.F14., Charts 5A to 5G.

C4.7.2. REDDISH OR RED-BROWN--COPPER. Add acidified ferric chloride (4), react for 15 to 30 seconds, and wash with a fine stream of water.

C4.7.2.1. A dark spot indicates phosphorus or arsenic is present. Identify by chemical analysis.

C4.7.2.1.1. The presence of phosphorus identifies *Phosphor Copper*.

C4.7.2.1.2. The presence of arsenic identifies *Arsenical Copper*.

C4.7.2.2. No dark spot indicates tough-pitch copper, or oxygen-free high-conductivity copper.

C4.7.2.2.1. To differentiate between phosphorized and arsenical coppers, chemical analysis of spectrographic examination is used. There are several methods of differentiating between tough-pitch and oxygen-free high-conductivity copper, all of which concern the detection of oxygen or cuprous oxide. Since this type of examination is beyond the scope of the average scrap yard, it is suggested that this material be classified as Number 1 or Number 2 copper in accordance with the Specification Grades, as indicated in Chapter 6 or in accordance with acceptable trade practices.

C4.7.2.2.2. Copper-base alloys are so numerous and varied in chemical composition that there are few simple tests that can give reliable indications of all the alloying elements. Spot tests are less reliable than spectrographic examination or chemical analysis because the intense blue color of the copper compounds tends to mask subsequent observations.

C4.7.3. DARK YELLOW-BRONZES. Dissolve a small specimen in a beaker with 1:1 nitric acid (26) and boil.

C4.7.3.1. A finely divided white precipitate identifies a *Tin-Bronze*.

C4.7.3.2. A gelatinous mass identifies a *Silicon-Bronze*.

C4.7.3.3. Filter the precipitate or gelatinous mass and add 1:1 sulfuric acid (47) to the filtrate.

C4.7.3.3.1. A white precipitate forming on short standing identifies a *Leaded Bronze*.

C4.7.3.3.2. No precipitate indicates a copper-beryllium alloy or aluminum bronze.

C4.7.3.4. Dissolve approximately 0.5 gm. of a fresh specimen in a beaker with a mixture of 1:1 nitric acid (26) and 1:1 orthophosphoric acid (30), dilute to 75 to 100 ml., and a few drops of a 1 percent solution of silver nitrate (37) and 25 ml., of a 6 percent solution of ammonium persulfate (11), and boil. A purple color identifies *Manganese Bronze*.

C4.7.4. LIGHT YELLOW-BRASSES

C4.7.4.1. Dissolve a small specimen in a beaker with 1:1 nitric acid (26) and bring to a boil.

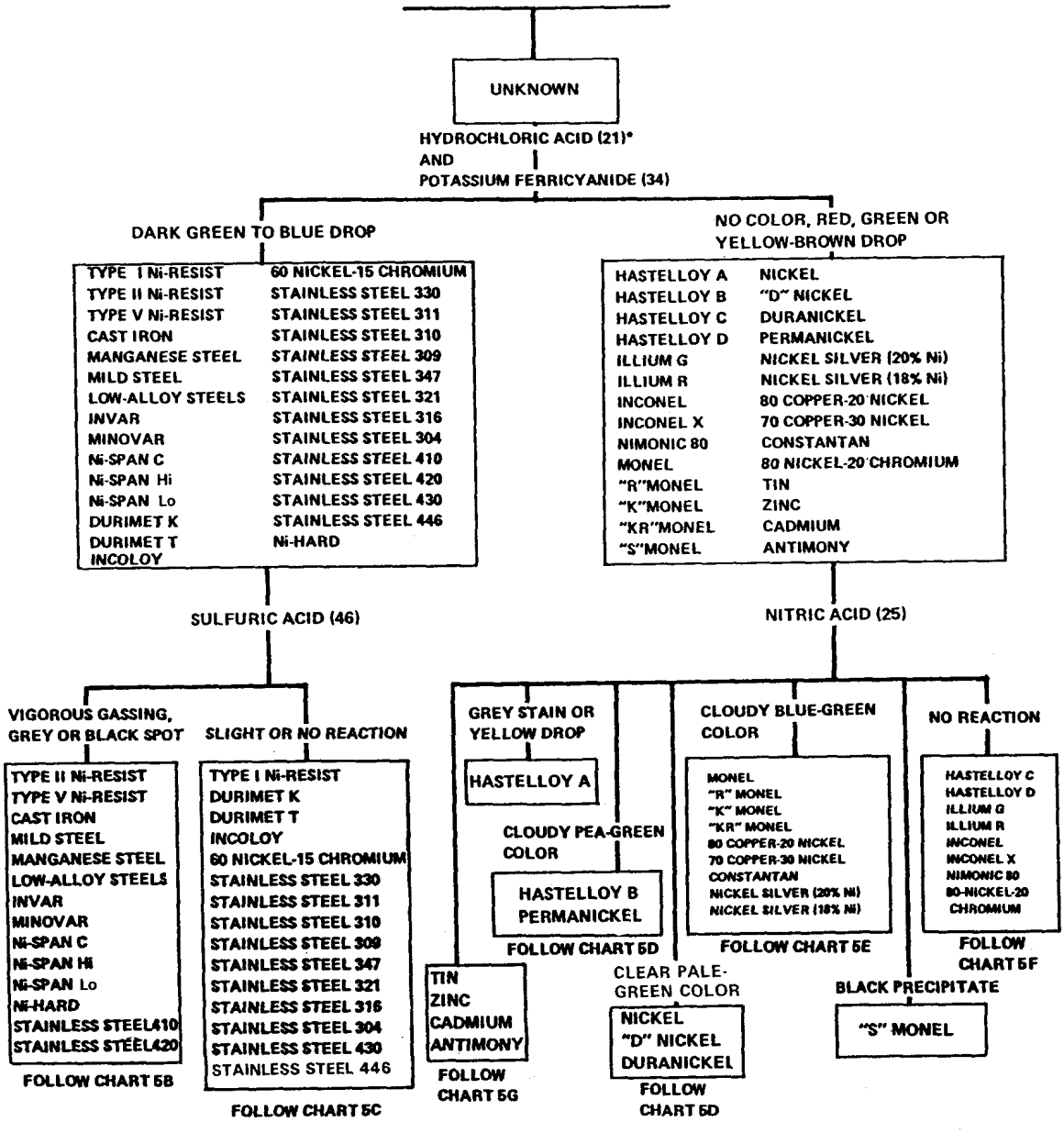
C4.7.4.2. A finely divided white precipitate of metastannic acid shows that tin is present and that the material is probably *Admiralty Metal* or *Naval Brass*. Naval Brass has a darker yellow color than Admiralty Metal, due to the presence of beta phase in its structure.

C4.7.4.3. In the absence of tin, a gelatinous precipitate of aluminum hydroxide obtained upon the addition of ammonia to a faint alkalinity identifies the material as aluminum brass, while a heavy white precipitate (lead sulfate) obtained upon the addition of sulfuric acid indicates free turning brass. To test for aluminum, take 2 or 3 drops of a mixture of 1:1 hydrochloric acid (20) and 1:1 nitric acid (26). Make alkaline with 1 ml. potassium hydroxide (35) and add 1 or 2 drops of alizarin S solution (5).

C4.7.4.3.1. A red color identifies *Aluminum Brass*.

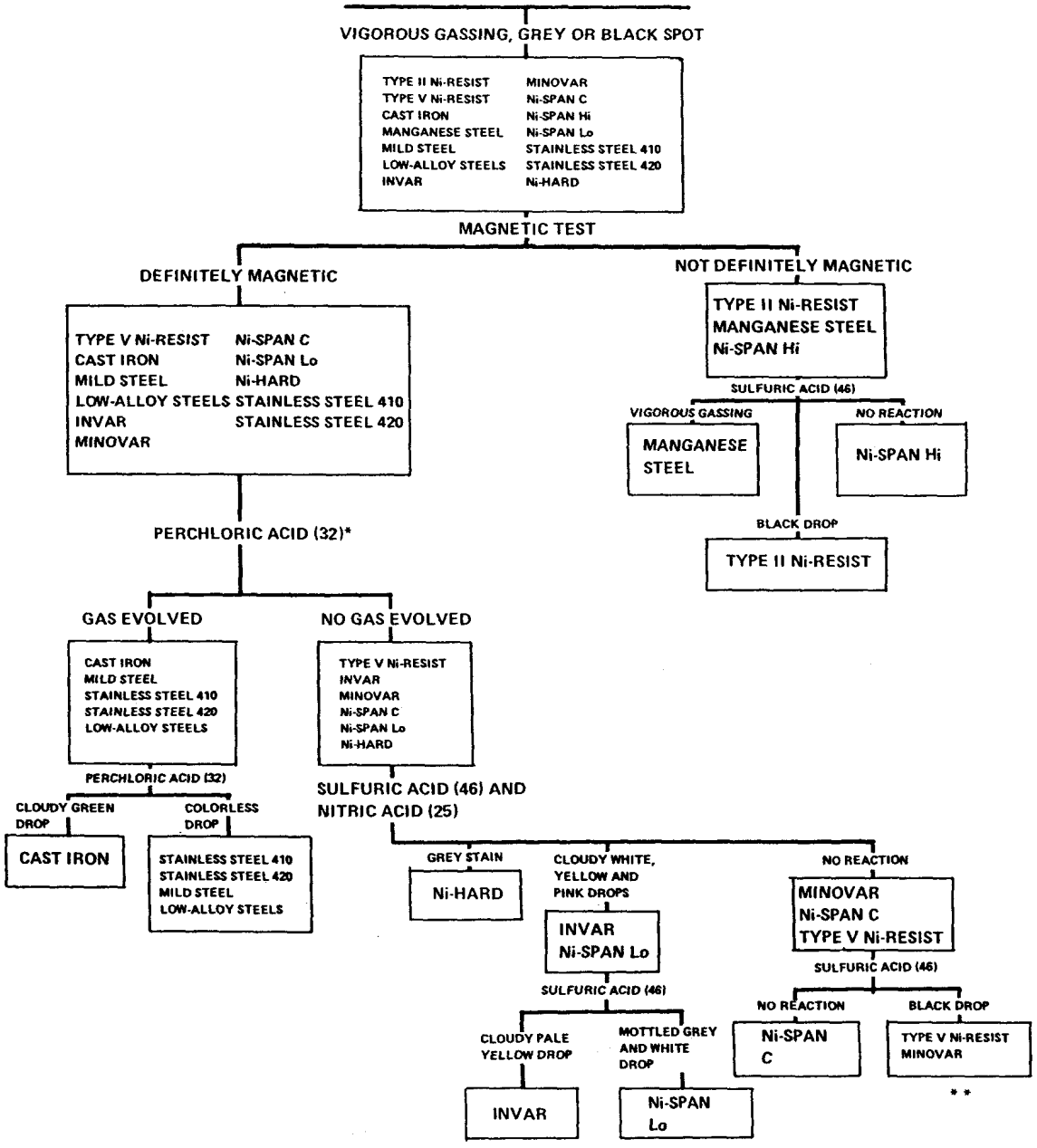
C4.7.4.3.2. The absence of tin, aluminum, and lead identifies Yellow Brass (copper 65 to 75 percent).

Figure C4.F8. Chart 5-A.
Identification of Ferrous and Nonferrous Metals and Alloys
(Specific Gravity 6 to 9)



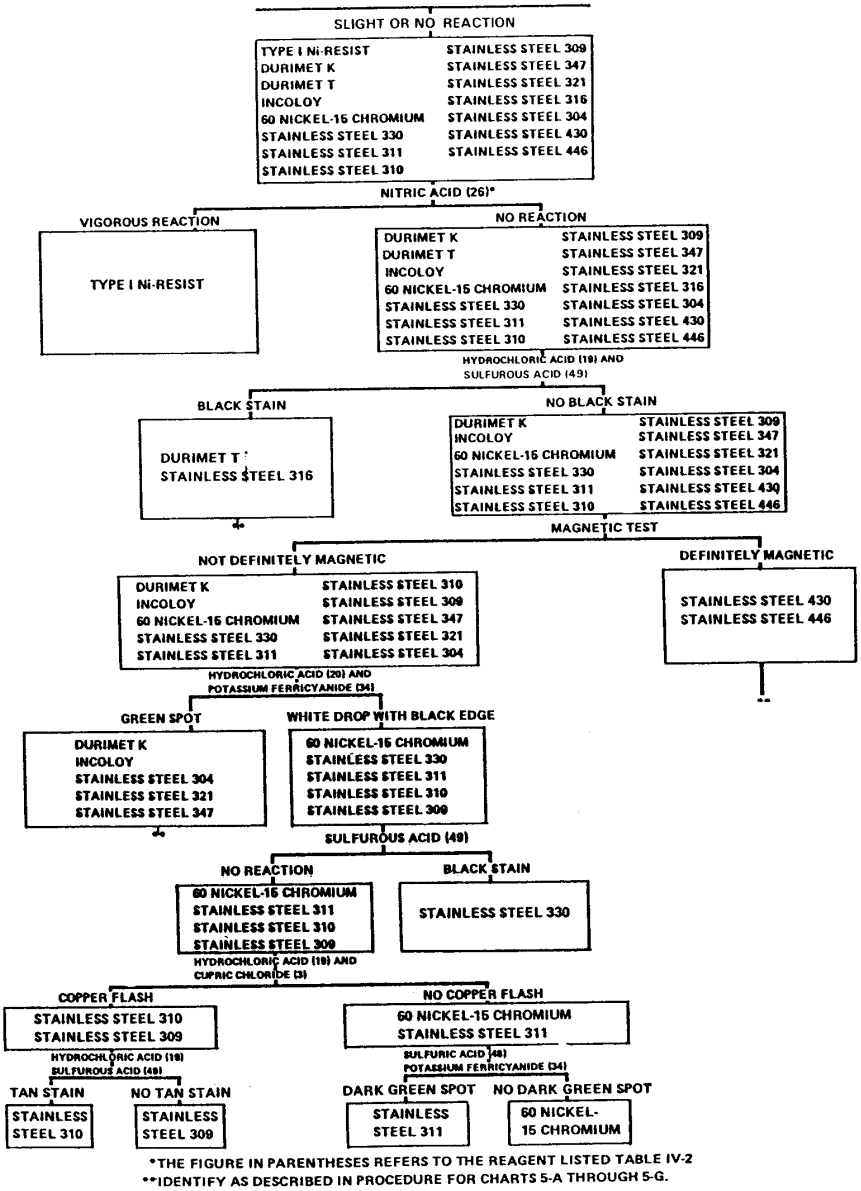
*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2

Figure C4.F9. Chart 5-B.
Identification of Ferrous and Nonferrous Metals and Alloys
Continued from Chart 5A.



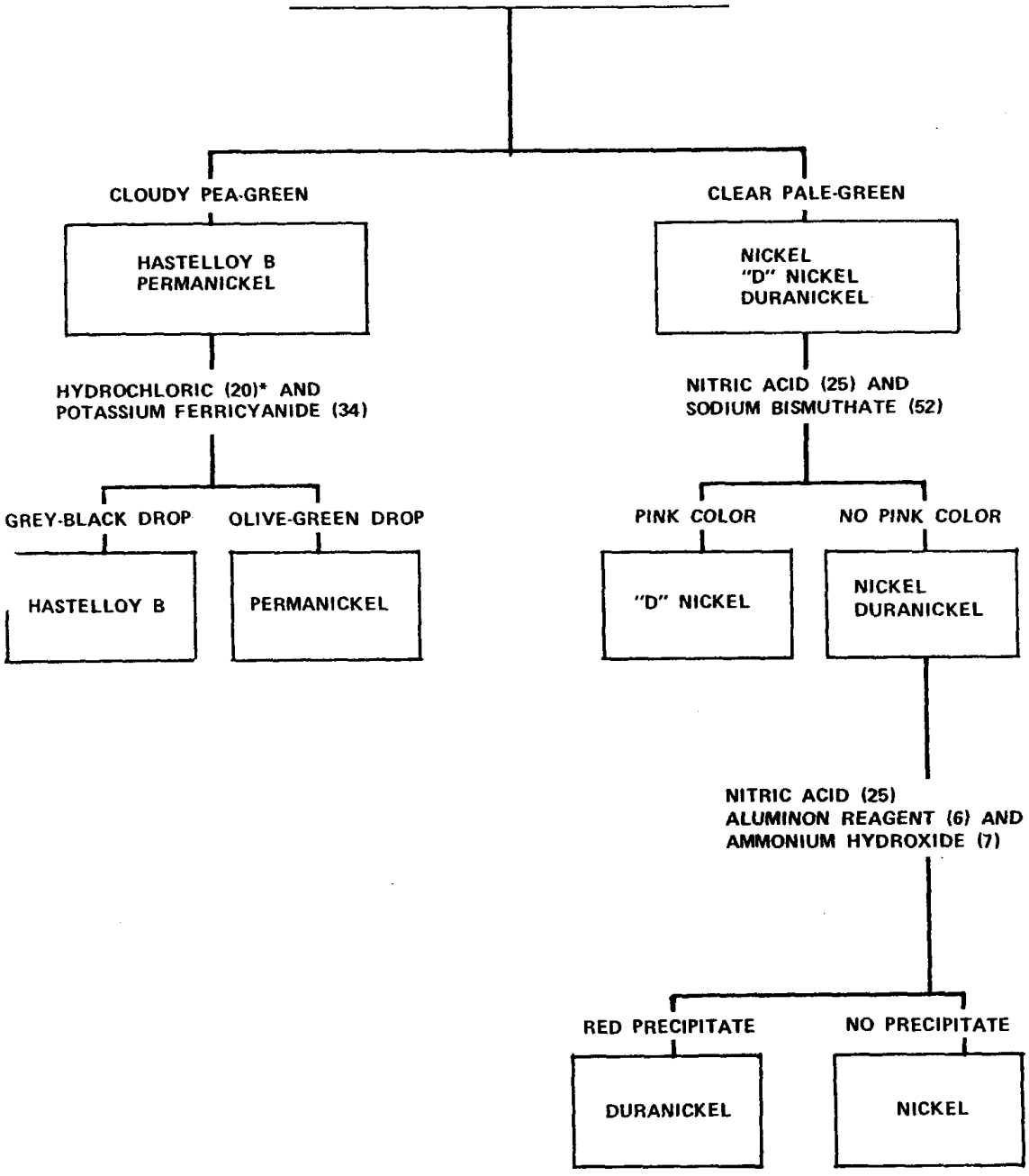
*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2
**IDENTIFY AS DESCRIBED IN PROCEDURE FOR CHARTS 5-A THROUGH 5-G

Figure C4.F10. CHART 5-C.
Identification of Ferrous and NonferrousMetals and Alloys, Continued from Chart 5A.



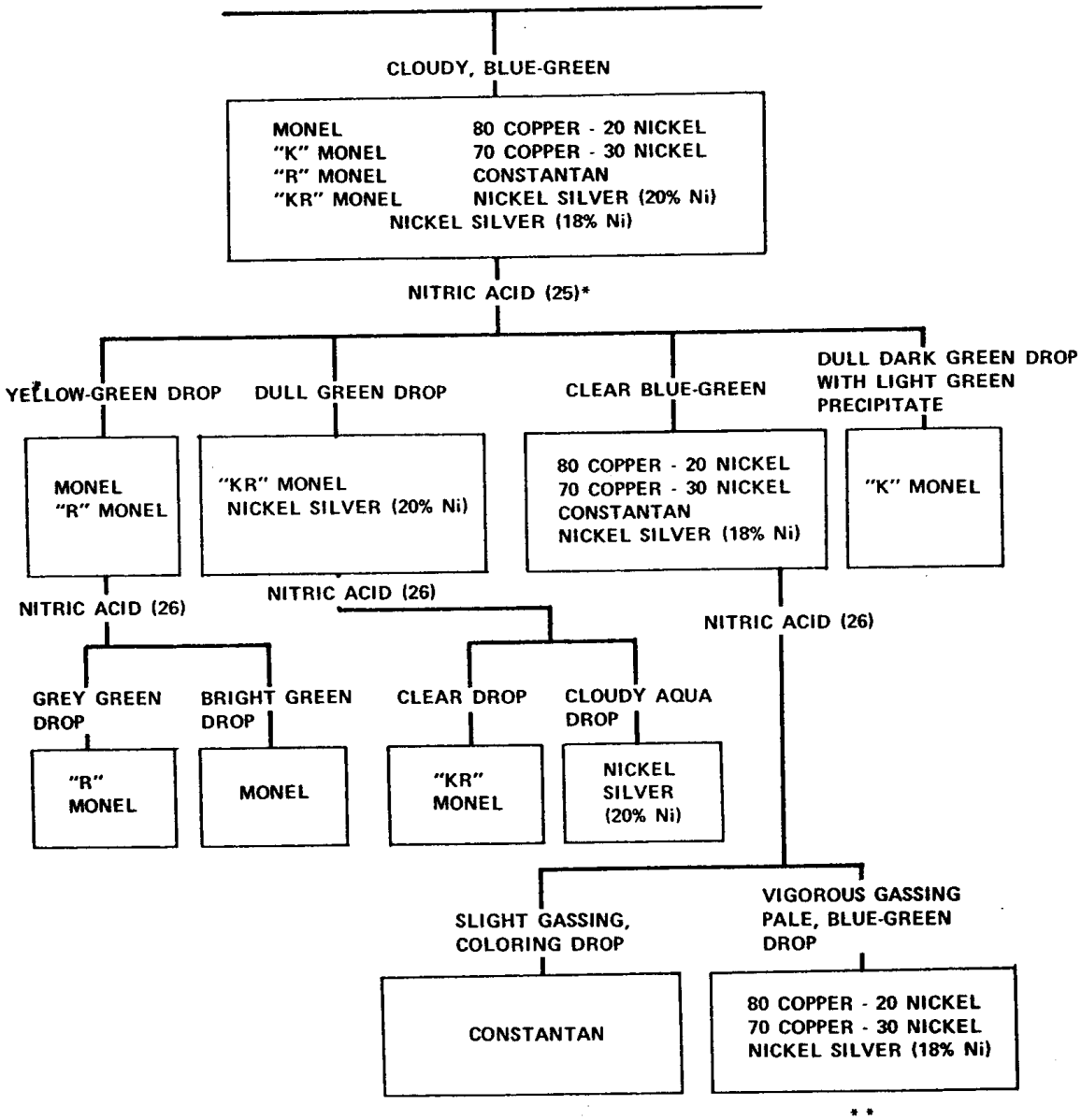
*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED TABLE IV-2
**IDENTIFY AS DESCRIBED IN PROCEDURE FOR CHARTS 5-A THROUGH 5-G.

Figure C4.F11. CHART 5-D.
Identification of Ferrous and Nonferrous Metals and Alloys
Continued from Chart 5A.



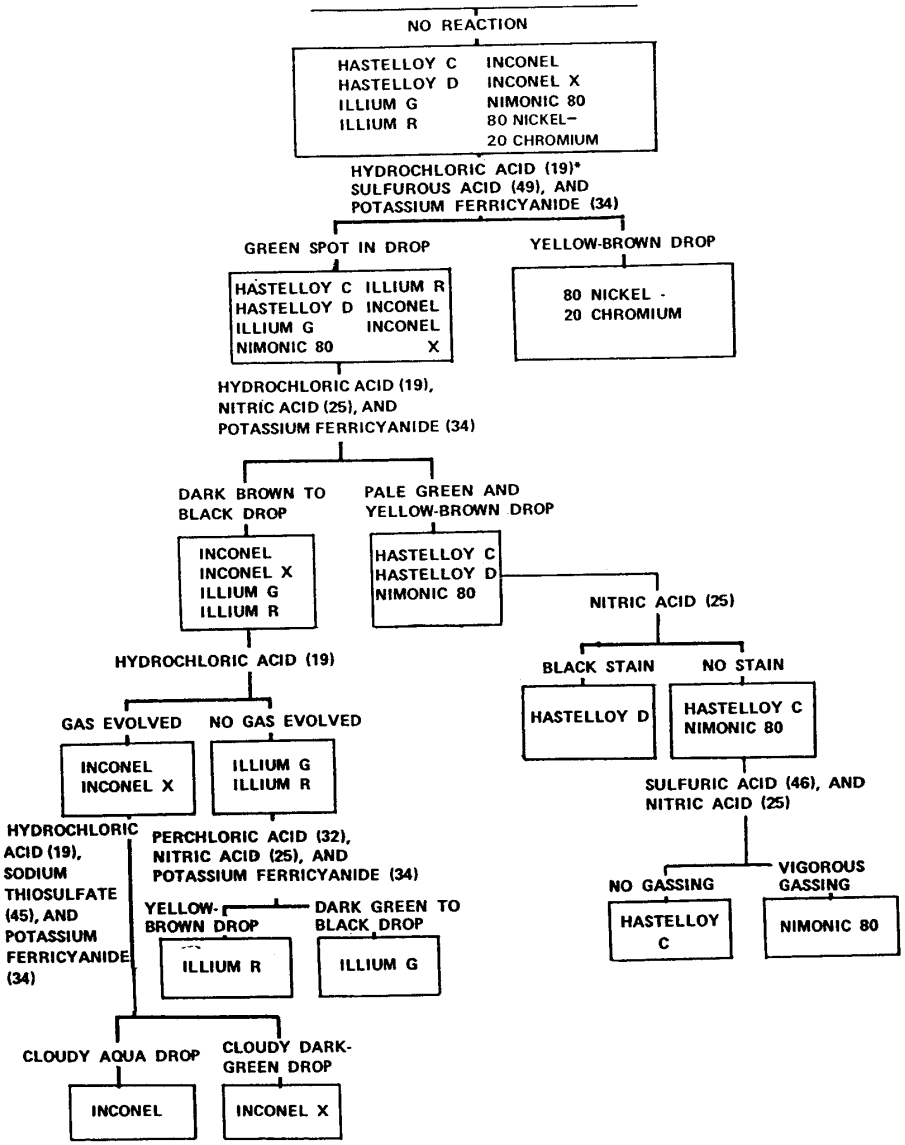
*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2

Figure C4.F12. CHART 5-E.
Identification of Ferrous and Nonferrous Metals and Alloys
Continued from Chart 5A.



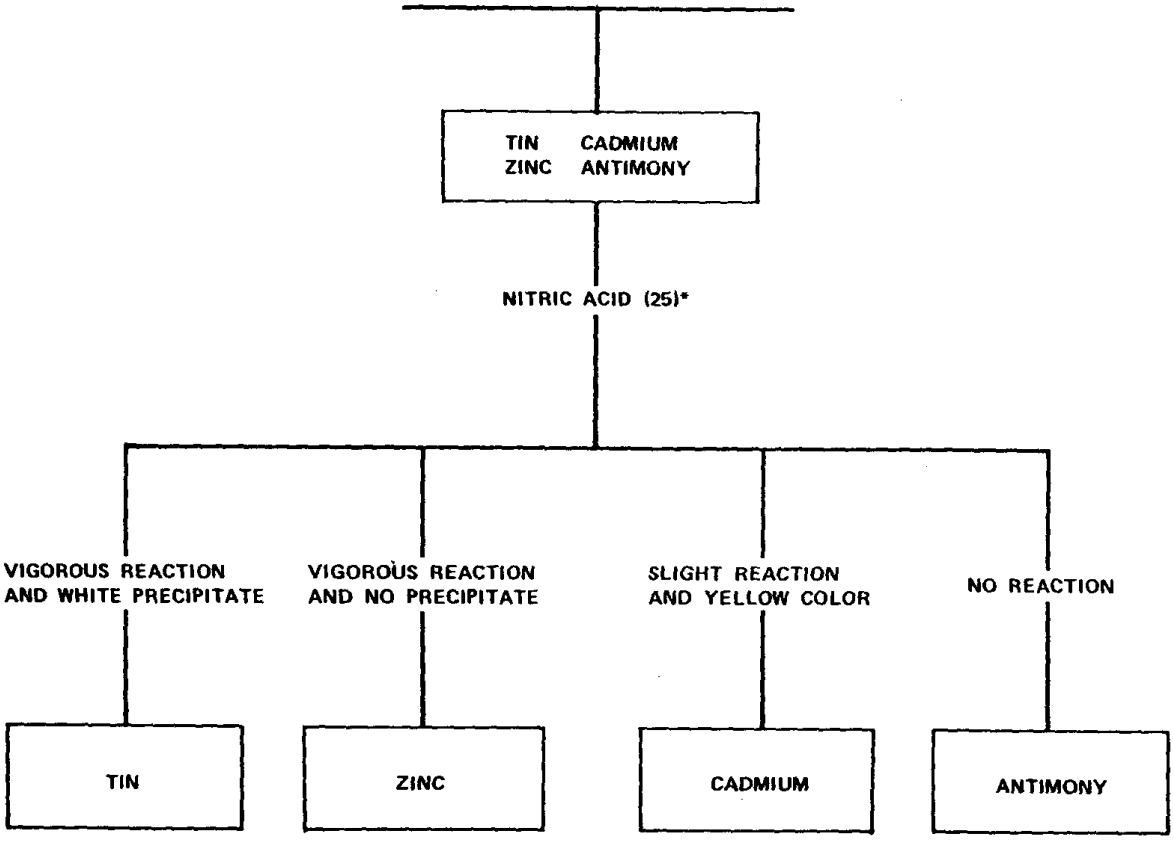
*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2
**IDENTIFY AS DESCRIBED IN PROCEDURE FOR CHARTS 5-A THROUGH 5-G

Figure C4.F13. CHART 5-F.
Identification of Ferrous and Nonferrous Metals and Alloys
Continued from Chart 5A.



*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2

Figure C4.F14. CHART 5-G.
Identification of Ferrous and Nonferrous Metals and Alloys
Continued from Chart 5A.



*THE FIGURE IN PARENTHESES REFERS TO THE REAGENT LISTED IN TABLE IV-2

C4.8. PROCEDURE FOR CHARTS 5A THROUGH 5G

Consult Figures C4.F8. through C4.F14., Charts 5A through 5G.

C4.8.1. WHITE AND OXIDIZED Nickel, high-nickel alloys, nickel silvers, cupro-nickels, Stainless steel, tin, zinc, antimony, and cadmium, steels, and cast irons. (Consult Figure C4.F8., Chart 5A.)

C4.8.1.1. Add 10 percent hydrochloric acid (21) and allow to react for 1 minute. Then add 10 percent potassium ferricyanide (34) and observe at the end of 30 seconds.

C4.8.1.1.1. A dark-green to blue drop indicates Type I Ni-Resist, Type 11 Ni-Resist, Type V Ni-Resist, cast iron, mild steel, manganese steel, low-alloy steels, Invar, Minovar, Ni-Span C, Hi-Span Hi, Ni-Span Lo, Ni-Hard, Durimet K, Durimet T, 60 nickel-15 chromium, and stainless steels 330, 311, 310, 309, 304, 316, 321, 347, 410, 420, 430 and 446. Add sulfuric acid (46) and observe at the end of 1 minute.

C4.8.1.1.2. Vigorous gassing, or a gray or black spot, indicates Type II Ni-Resist, Type V Ni-Resist, steel, low-alloy steels, Invar, Minovar, Ni-Span C, Ni-Span Lo, Ni-Hard, and stainless steels 410 and 420. (Consult Figure C4.F9., Chart 5B.) Test with an Alnico magnet.

C4.8.1.1.3. If the material is definitely magnetic, it may be Type V Ni-Resist, cast iron, mild steel, low-alloy steels, Invar, Minovar, Ni-Span C, Ni-Span Lo, Ni-Hard, or stainless steels 410 and 420. Add perchloric acid (32) and observe at the end of 15 seconds.

C4.8.1.1.4. Evolution of gas indicates mild steel, low-alloy steels, cast iron, or stainless steels 410 and 420.

C4.8.1.2. Then add perchloric acid (32) to a fresh surface and observe at the end of 2 minutes.

C4.8.1.2.1. A cloudy green drop identifies *Cast Iron*

C4.8.1.2.2. A clear color drop identifies *Mild Steel, Stainless Steel 410* or *Stainless Steel 420*.

C4.8.1.2.3. The chromium-containing stainless steels are considerably harder than mild steel and can be separated from mild steel by a hardness test. Identify the low-alloy steels by the spark test procedures or by one of the following tests:

C4.8.1.2.3.1. *Nickel*--React to completion with 1 or 2 drops of 1:1 nitric acid (26): Neutralize with a slight excess of zinc oxide (56). Add a few drops of standard dimethylglyoxime solution (17). A pink color identifies *Nickel*. The limit of detectability is 0.05 percent.

C4.8.1.2.3.2. *Chromium*--Mix equal volumes of potassium cobalticyanide (33), bromine water(14), and 20 percent sodium hydroxide (42). React to completion with a drop of the mixture and allow to dry. Gentle warming may be used to hasten drying. Repeat the procedure on a surface of known chromium content. Place a drop of diphenylcarbazide solution (18) on the dried spot. A more or less fugitive purple coloration identifies *Chromium*. Comparison with the known sample indicates level of chromium present. Avoid contact of the skin with chemicals used m this test

C4.8.1.2.3.3. *Molybdenum*--React to completion with 1 or 2 drops of 1:1 nitric acid (26). Remove reaction products with paper or cloth. React again with 1 drop of 20 percent sulfuric acid (48) and immerse a piece of filter paper saturated with a 10 percent solution of potamium ethyl xanthogenate (.33). For molybdenum steels that are difficult to dissolve, react to completion with 3 drops of 1:1 hydrochloric acid (20), neutralize with 1 drop of 20 percent hydroxide (41), acidity with 1 drop of 20 percent sulfuric acid (48), and add a few xanthogenate crystals (51). A red color identifies *Molybdenum*. The limit of detectability is 0.1 percent.

C4.8.1.2.3.4. *Vanadium*--React to completion with 1 or 2 drops of 1:1 nitric acid (26). Add 1 drop of orthophosphoric acid (29), a small crystal of sodium fluoride (53) if titanium is present, and then 1 drop of a 3 percent solution of hydrogen peroxide (23). A reddish-brown color identifies *Vanadium*. The limit of detectability is 0.1 percent. As an alternate, react with 1:1 nitric acid (26), neutralize with 1 drop of a 40 percent solution of sodium hydroxide (40), acidity with 1 drop of 1:1 acetic acid (2), and add 1 drop of 1,8-oxyquinoline (31). A greenish-black to black color identifies *Vanadium*. The limit of detectability is 0.2 percent.

C4.8.1.2.3.5. *Silicon*--React to completion with 1 or 2 drops of hydrochloric acid (19) and add 1 drop of water. White particles, which rise to the surface in the form of a yellowish foam, indicate silicon. Then add 1 drop of 2 Molar sodium hydroxide solution (42), acidity with 1 drop of 1:1 hydrochloric acid (20), and add 1 drop of ammonium molybdate solution (8). A yellow color, which forms slowly, indicates silicon. Then add 1 drop of a solution containing 0.05 g. of benzidine hydrochloride (14). A blue color identifies *Silicon*. The limit of detectability is 0.3 percent.

C4.8.1.2.3.6. *Aluminum*--React to completion with 2 or 3 drops of a mixture of 1:1 hydrochloric acid (20) and 1:1 nitric acid (26). Make alkaline with 1 Molar potassium hydroxide (35) and add 1 or 2 drops of alizarin S solution (5). A red color indicates *Aluminum*. Beryllium and copper form a red color also. Add a few

drops of 1:1 acetic acid (2) to dissolve beryllium and copper. If the red color remains, *Aluminum* is confirmed. The limit of detectability is 0.02 percent.

C4.8.2. No evolution of gas indicates Type V Ni-Resist, Invar, Minovar, Ni-Span C, Ni-Span Lo, or Ni-Hard. Add 2 drops sulfuric acid (46), 1 drop nitric acid (25), and observe at the end of 2 minutes.

C4.8.2.1. A gray stain identifies *Ni-Hard*.

C4.8.2.2. A cloudy, white, yellow, and pink color indicates Invar or Ni-Span Lo. Add sulfuric acid (46) and observe at the end of 3 minutes.

C4.8.2.2.1. A cloudy, pale yellow drop identifies *Invar*.

C4.8.2.2.2. A mottled gray and white drop identifies *Ni-Span Lo.*

C4.8.2.3. No reaction indicates Type V Ni-Resist, Minovar, or Ni-Span C. Add sulfuric acid (46) and observe at the end of 1 minute.

C4.8.2.3.1. No reaction identifies *Ni-Span C.*

C4.8.2.3.2. A black color indicates Type V Ni-Resist or Minovar.

C4.8.3. Identify *Type V Ni-Resist* and *Minovar* by chemical or spectrographic analysis. Or, immerse a known specimen of one alloy and the unknown specimen in 20 percent sulfuric acid (48) and connect them to the terminals of a 0-1milliammeter. No permanent deflection of the ammeter needle identifies the known and unknown specimens as the same alloy: a permanent deflection of the needle identifies the unknown specimen as a different alloy than the known specimen.

C4.8.3.1. If the material is not definitely magnetic, it may be Type Ill Ni-Resist, manganese steel, or Ni-Span Ni. Add sulfuric acid (46) and observe at the end of 15 seconds.

C4.8.3.1.1. Vigorous gassing identifies *Manganese Steel*.

C4.8.3.1.2. A black drop identifies *Type II Ni-Resist*.

C4.8.3.1.3. No reaction identifies *Ni-Span Hi.*

C4.8.3.2. No reaction, or a slight reaction, indicates Type I Ni-Resist, Durimet K, Durimet T, 60 Nickel-15 chromium, and stainless steels 330, 311, 310, 309, 304, 316, 321, 347, 430, 446. Add 1:1 nitric acid (26) and observe at the end of 15 seconds.

C4.8.3.2.1. A vigorous reaction identifies *Type I Ni-Resist*.

C4.8.3.2.2. No reaction indicates Durimet, Durimet T, 60 nickel-15 chromium, and stainless steels 330, 311, 310, 309, 304, 316, 321, 347, 430, and 446. Add hydrochloric acid (19) and allow to react for 1 minute. Then add 6 percent sulfurous acid (49) and observe at the end of 30 seconds.

C4.8.3.2.3. A black stain indicates Durimet T or stainless steel 316.

C4.8.3.2.3.1. Identify Durimet T and stainess steel 316 by chemical or spectographic analysis. Or, (see paragraph C4.8.3., above) by the use of a milliameter, using 10 percent hydrochloric acid (21) of 20 percent sulfuric acid (48).

C4.8.3.2.3.2. The absence of a black stain indicates Durimet K Incoloy, 60 nickel--15 chromium, or stainess steels 330, 311, 310, 309, 304, 321, 347, 430 and 446. Test with an Alnico magnet.

C4.8.3.2.3.3. If the material is definitely magnetic, it is *Stainless Steel 430* or *Stainless Steel 446*.

C4.8.3.2.3.4. If the material is not defintely magnetic, it may be Durimet K, Incoloy, 60 nickel-15 chromium, or stainless steels 330, 311, 310, 309, 304, 321, or 347. Add 1:1 hydrochloric acid (20), allow to react, and add 1 drop of 10 percent potassium ferricyanide (34).

C4.8.3.2.3.5. A green spot indicates *Durimet K, Incoloy, stainless steels 304, 321 or 347*.

C4.8.3.2.3.5.1. Identify *Durimet K* by the presence of copper on chemical or spectrographic analysis.

C4.8.3.2.3.5.2. Identify *Incoloy* by determination of nickel on chemical or spectrographic analysis.

C4.8.3.2.3.5.3. Identify *Stainless Steel 304* by the absence of titanium and columbium on chemical or spectrographic analysis.

C4.8.3.2.3.5.4. Identify *Stainless Steel 321* by the presence of titanium on chemical or spectrographic analysis.

C4.8.3.2.3.5.5. Identify *Stainless Steel 347* by the presence of columbium on chemical or spectrographic analysis.

C4.8.3.2.3.6. A white drop with a black edge indicates 65 nickel--15 chromium, or stainless steels 330, 311, 310 or 309. Add 6 percent sulfurous acid (49) to a fresh surface and observe at the end of 1 minute.

C4.8.3.2.3.6.1. A black stain identifies *Stainless Steel 330*.

C4.8.3.2.3.6.2. No reaction indicates 60 nickel--15 chromium, or stainless steels 311, 310 or 309. The following procedures will give positive results only when the alloys contain no precipitated carbides and are in the same annealed or cold-worked condition. Add 1 drop of hydrochloric acid (19) and 1 drop of acidified cupric chloride (3) to a fresh surface and observe at the end of 1 minute.

C4.8.3.2.3.6.3. A copper flash indicates stainless steels 310 or 309. Add hydrochloric acid (19), sulfuric acid (46), and 6 per cent sulfurous acid (49), and observe at the end of 1 minute.

C4.8.3.2.3.6.4. A tan stain identifies *Stainless Steel 310*.

C4.8.3.2.3.6.5. No tan stain identifies *Stainless Steel 309*.

C4.8.3.2.3.6.6. No copper flash indicates *Stainless Steel 311* or 60 nickel--15 chromium. Add 20 percent sulfuric acid (48) and a drop of 10 percent potassium ferricyanide (34) and observe at the end of 1 minute.

C4.8.3.2.3.6.7. A dark green spot identifies *Stainless Steel 311*.

C4.8.3.2.3.6.8. No dark green spot identifies *60 Nickel--15 Chromium*.

C4.8.3.2.4. A red, green, or yellow-brown drop, or no color, indicates Hastelloy A, Hastelloy B, Hastelloy C, Hastelloy D, Illium G, Illium R, Inconel, Inconel X, Nimonic 80, Monel, "K" Monel, "R" Monel, "KR" Monel, "S" Monel, Nickel, "D" Nickel, Duranickel, Permanickel, Nickel Silver (20% Ni), Nickel Silver (18% Ni), 80 copper--20 nickel, 70 copper--30 nickel, Constantan, 80 nickel--20 chromium, tin, zinc, cadmium, and antimony. (Consult Figure C4.F8., Chart 5A.) Add nitric acid (25) and observe at the end of 1 minute.

C4.8.3.2.4.1. A gray stain and yellow color identifies *Hastelloy A.*

C4.8.3.2.4.2. A black precipitate identifies *"S" Monel*.

C4.8.3.2.5. A cloudy, pea-green color indicates Hastelloy B or Permanickel. (Consult Figure C4.F11., Chart 5D). Add 1:1 hydrochloric acid (20) and allow to react for 1 minute. Then add 10 percent potassium ferricyanide (34) and observe at the end of 1 minute.

C4.8.3.2.5.1. A gray-black drop identifies *Hastelloy B.*

C4.8.3.2.5.2. An olive-green drop identifies *Permanickel*.

C4.8.3.2.6. A clear, pale green colored drop indicates nickel, "D" Nickel, or Duranickel. (Consult Figure C4.F11., Chart 5D.) Add nitric acid (25) and allow to react for 1 minute. Then add a drop of water and a few crystals of sodium bismuthate (52). Stir and observe at the end of 30 seconds.

C4.8.3.2.6.1. A pink color ideutifies *"D" Nickel*.

C4.8.3.2.6.2. The absence of color indicates nickel or Duranickel. Add nitric acid (25) and allow to react for 1 minute. Then add 1 drop of aluminum reagent (6) and 3 drops of ammonium hydroxide (7). Stir and observe at the end of 5 seconds.

C4.8.3.2.6.2.1. A red precipitate identifies *Duranickel*.

C4.8.3.2.6.2.2. No precipitate identifies *Nickel*.

C4.8.3.2.7. A cloudy, blue-green color indicates "K" Monel, Monel, "R" Monel, "KR" Monel, 80 copper--20 nickel, 70 copper--30 nickel, Constantan, nickel silver (20% nickel) or nickel silver (18% nickel). (Consult Figure C4.F12., Chart 5E.) Add nitric acid (25) and observe at the end of 5 minutes.

C4.8.3.2.7.1. A dull, dark-green color with a light-green precipitate identifies *"K" Monel*.

C4.8.3.2.7.2. A dull, green color indicates nickel silver (20% Nickel) or "KR" Monel. Add 1:1 nitric acid (26) and observe at the end of 10 seconds.

C4.8.3.2.7.2.1. A clear drop identifies *"KR" Monel*.

C4.8.3.2.7.2.2. A cloudy aqua drop identifies *Nickel Silver* (20% *Nickel*).

C4.8.3.2.7.3. A yellow-green color indicates Monel or "R" Monel. Add 1:1 nitric acid (26) and observe at the end of 8 minutes.

C4.8.3.2.7.3.1. A bright green color identifies *Monel*.

C4.8.3.2.7.3.2. A grey-green color identifies *"R" Monel*.

C4.8.3.2.7.4. A clear, blue-green color indicates nickel silver (18% Ni), 80 copper--20 nickel, 70 copper--30 nickel, or Constantan. Add 1:1 nitric acid (26) and observe at the end of 5 seconds.

C4.8.3.2.7.4.1. Slight gassing and a colorless drop identifies (*55 Copper--45 Nickel) Constantan*.

C4.8.3.2.7.4.2. Vigorous gassing and a pale, blue-green drop indicate nickel silver (18% nickel), 80 copper--20 nickel, or 70 copper--30 nickel.

C4.8.3.2.7.4.3. Identify *Nickel Silver (18% nickel), 80 Copper 20 Nickel*, and *70 Copper--30 Nickel* by chemical or spectrographic analysis.

C4.8.3.2.8. No reaction indicates Hastelloy C, Hastelloy D, Illium G, Illium R, Inconel, Inconel X, Nimonic 80, and 80 nickel--20 chromium. (Consult Figure C4.F13., Chart 5F.) Add hydrochloric acid (19), 1 drop of 6 percent sulfurous acid (49), and allow to react for 1 minute. Then add 1 drop 10 percent potassium ferricyanide (34) and observe at the end of 1 minute.

C4.8.3.2.8.1. A yellow-brown drop identifies *80 Nickel--20 Chromium Alloy*.

C4.8.3.2.8.2. A green drop indicates Hastelloy C, Hastelloy D, Illium G, Illium R, Inconel, Inconel X, and Nimonic 80. Add hydrochloric acid (19), nitric acid (25) and allow to react for 1 minute. Then add 10 percent potassium ferricyanide (34) and observe after 1 minute. A dark brown to black color indicates Inconel, Inconel X, Illium G, or Ilhum R. Add hydrochloric acid (19) and observe at the end of 10 seconds.

C4.8.3.2.8.3. If gas is evolved, the material is Inconel or Inconel X. Add another drop of hydrochloric acid (19) and allow to react for 1 minute. Then add 1 drop of sodium thiosulfate (45) and allow to react for 1 minute. Finally, add 1 drop of potassium ferricyanide (34), stir, and observe at the end of 5 minutes.

C4.8.3.2.8.3.1. A cloudy, aqua drop identifies *Inconel*.

C4.8.3.2.8.3.2. A cloudy, dark-green drop identifies *Inconel X*.

C4.8.3.2.8.4. If no gas is evolved, the material is Illium G or Illium R. Add perchloric acid (32), nitric acid (25), and allow to react for 1 minute. Then add 1 drop 10 percent potassium ferricyanide (34), and observe at the end of 1 minute.

C4.8.3.2.8.4.1. A yellow-brown colored drop identifies *Illium R.*

C4.8.3.2.8.4.2 A dark green to black colored drop identifies *Illium G.*

C4.8.3.2.8.5. A pale green and yellow-brown drop indicates Hastelloy C, Hastelloy D, or Nimonic 80. Add nitric acid (25) and observe at the end of 1 minute.

C4.8.3.2.8.5.1. A black stain identifies *Hastelloy D.*

C4.8.3.2.8.5.2. No stain idicates Hastelloy C or Nimonic 80.

C4.8.3.2.8.6. Add sulfuric acid (46) and nitric acid (25) and observe at the end of 5 seconds.

C4.8.3.2.8.6.1. Vigorous gassing identifies *Nimonic 80*.

C4.8.3.2.8.6.2. No gassing identifies *Hastelloy C.*

C4.8.3.2.9. If the material is known to be tin, zinc, antimony, or cadmium, place it in nitric acid (25), in a test tube and observe at the end of 1 minute. (Consult Figure C4.F14., Chart 5G.).

C4.8.3.2.9.1. A vigorous reaction and a white precipitate identifies *Tin*.

C4.8.3.2.9.2. A vigorous reaction and no precipitate identifies *Zinc*.

C4.8.3.2.9.3. A slight reaction and a yellow-colored solution identifies *Cadmium*.

C4.8.3.2.9.4. No reaction identifies *Antimony*.

C4.8.4. Chemical Testing (see Table C4.T2.)

C4.8.4.1. Spot test kits for general use in the scrap yard contain reagents that are capable of identifying the most common metals in scrap yards. These reagents include concentrated acids that are very dangerous. When using reagents the following precautions should be followed:

C4.8.4.1.1. Ensure work area is well ventilated.

C4.8.4.1.2. Safety glasses or a safety shield should be worn to protect face and eyes.

C4.8.4.1.3. Cotton or rubberized gloves will protect skin from immediate contact with corrosives.

C4.8.4.1.4. Whenever possible use the test kit where an emergency eyewash is immediately available.

C4.8.4.1.5. When a test solution is spilled onto the skin or protective clothing, wash the area thoroughly for 5 minutes. Skin damage can occur over a period of time and may not be immediately noticeable or painful.

C4.8.4.1.6. Prevent dangerous chemical reactions by always slowly pouring chemicals into water. Never pour water into concentrated chemicals as this can cause extremely dangerous high heat reactions resulting in splashing and burns.

C4.8.4.1.7. Always wash face and hands after working with chemicals. This helps reduce the possibility of skin irritation or dermatoses.

C4.8.4.2. The reagents most commonly used in chemical testing include:

C4.8.4.2.1. Nitric acid, concentrated (HNO_3). Sp. gr. 1.42.

C4.8.4.2.2. Hydrochloric acid, concentrated (HCl). Sp. gr. 1.18.

C4.8.4.2.3. Silver nitrate solution (0.5percent $AgNO_3$, 100 ml. H_2O).[1] Dissolve 0.5 gram of silver nitrate into 100 ml. of water.

C4.8.4.2.4. Potassium ferricyanide solution(10 percent $K_3Fe(CN)_6$, in H_2O). [1] Dissolve 10 gram of potassium ferricyanide in 100 ml. of water.

C4.8.4.2.5. Ammonium hydroxide, concentrated (NH_4OH). Sp. gr. 0.9.

C4.8.4.2.6. Solution B,[2] prepared as follows:

C4.8.4.2.6.1. Dissolve 1 gram dimethylglyoxime in 50 ml. acetic acid (glacial). (See Table C4.T2.)

C4.8.4.2.6.2. Add 10 ml. distilled water and 30 ml. NH_4OH concentrated ammonium hydroxide solution, then stir until all salts are in solution.

C4.8.4.2.6.3. Add 10 gram ammonium acetate.

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[1] This reagent, which has a safe shelf life of only 4 to 6 months, must be stored in opaque plastic bottles to prevent decomposition from exposure to light.

[2] The American Society of Testing Materials (ASTM) suggests that this solution be used in conjunction with other acids when testing for nickel in alloys. Alloys containing nickel will produce a pink or red color when added to sample after other acids have been applied.

C4.8.4.3. Before applying any of the above reagents [3] the surface of the sample must be cleaned with a file or a grinding wheel. It is also essential to apply reagents in the correct order. In certain instances, observation of the reaction speed is as vital to the chemical test as is recognition of colors and color combinations.

C4.8.4.4. Solution B and other required acids, salts and reagents should be prepared by the DoD host laboratory or any other nearby Government laboratory or they may be procured from private sector pharmacies, hospitals, or chemical laboratories.

C4.8.4.5. None of the above chemicals are listed in the hazardous materials table (40 CFR 261.33(e) and (f)) as hazardous wastes. Landfill disposal through existing service contracts is recommended.

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[3] Since these reagents have limited shelf lives when exposed to air, light and temperature changes, they should be replaced when spot tests on known samples fail to yield expected results.

Table C4.T2. Reagents and Testing Solutions

(Note: Use only freshly prepared solutions using distilled water as solute or solvent, as appropriate.)

1. Acetic acid, concentrated (glacial)	Sp. gr. 1.049
2. Acetic acid, 1:1	Add 50 ml. of glacial acetic acid to 50 ml. of water.
3. Acidified cupric chloride	Dissolve 10 g. of cupric chloride in 10 ml. of concentrated hydrochloric acid and dilute to 100 ml.
4. Aciditied ferric chloride	Dissolve 10 g. of ferric chloride in 10 ml. of concentrated hydrochloric acid and dilute to 100 ml.
5. Alizarin S	Dissolve 0.1 g. of Alizarin S in 100 ml. of water.
6. Aluminon reagent	Dissolve 0.1 g. of Aluminon in 100 ml. of water.
7. Ammonium hydroxide, concentrated	Sp. gr. 0.9.
8. Ammonium molybdate	Dissolve 5 g. of ammonium molybdate in 35 ml. of 1:2 nitric acid and dilute to 100 ml.
9. Ammonium oxalate, saturated	Prepare a saturated solution of ammonium oxalate in water.
10. Ammonium persulfate *	Prepare a saturated solution of ammonium persulfate in water.
11. Ammonium persulfate* 6 percent	Dissolve 6 g. of ammonium persulfate in 100 ml. of water.
12. Ammonium sulfide *	Prepare a saturated solution of hydrogen sulfide in1:9 ammonium hydroxide.
13. Aqua regia *	Mix 3 volumes of hydrochloric acid and 1 volume of nitric acid.
14. Benzidine hydrochloride	Dissolve 0.05 g. of benzidine hydrochloride in 10 ml. of glacial acetic acid and dilute to 100 ml.
15. Cadmium chloride	Dissolve 5 g. of cadmium sulfate and 3 g. of sodium chloride in 5 ml. of hydrochloric acid and dilute to 100 ml.
16. Chrome pickle *	Dow number 1 chemical treatment.
17. Dimethylglyoxime	Prepare a saturated solution of dimethylglyoxime in 100 ml. of 95 percent ethyl alcohol.
18. Diphenylcarbazide	Dissolve 1 g. of diphenylcarbazide in 100 ml. of 95 percent ethyl alcohol.
19. Hydrochloric acid, concentrated	Sp. gr. 1.18.
20. Hydrochloric acid, 1:1	Add 50 ml. of concentrated hydrochloric acid to 50 ml. of water.
21. Hydrochloric acid, 10 percent	Dilute 8 ml. of concentrated hydrochloric acid to 100 ml. of water.
22. Hydrofluoric acid, concentrated	48 percent.
23. Hydrogen peroxide, 3 percent	Dilute 10 ml. of 30 percent hydrogen peroxide to 100 ml. of water.
24. Mercuric chloride, 10 percent	Dissolve, 10 g. of mercuric chloride in 100 ml. of water.

Table C4.T2. Reagents and Testing Solutions, Continued

(Note: Use only freshly prepared solutions using distilled water as solute or solvent, as appropriate.)

25. Nitric acid, concentrated	Sp. gr. 1.42.
26. Nitric acid, 1:1	Add 50 ml. of concentrated nitric acid to 50 ml. of water.
27. Nitric acid, 1:2	Add 33 ml. of concentrated nitric acid to 67 ml. of water.
28. p-nitrobenzene-azo-alpha-naphthol	Dissolve0.001g.of -nitrobenzene-azo-alpha-naphthol in 100 ml. of 1 Msodium hydroxide.
29. Orthophosphoric acid, concentrated	85 percent
30. Orthophosphoric-acid, 1:1	Add 50 ml. of concentrated orthophosphoric acid to 50 ml. of water.
31. 1,8-oxyquinoline	Dissolve 2.5 g. 1,8-oxyquinoline in .6 ml. of glacial acetic acid and dilute to 100 ml.
32. Perchloric acid, concentrated	70 percent.
33. Potassium ethyl xanthogenate	Dissolve 10 g. of potassium ethyl xanthogenate in 100 ml. of water.
34. Potassium ferricyanide, 10 percent	Dissolve 10 g. of potassium ferricyanide in 100 ml. of water.
35. Potassium hydroxide, 1 Molar	Dissolve 5.6 g. of potassium hydroxide in 100 ml. of water.
36. Silver nitrate, 2 percent	Dissolve 2 g. of silver nitrate in 100 ml. of water.
37. Silver nitrate, 1 percent	Dissolve 1 g. of silver nitrate in 100 ml. of water.
38. Silver nitrate, 0.5percent	Dissolve 0.5 g. of silver nitrate in 100 ml. of water.
39. Silver nitrate, 0.2 percent	Dissolve 0.2 g. of silver nitrate in 100 mi. of water.
40. Sodium hydroxide, 40 percent	Dissolve 40 g. of sodium hydroxide in 100 ml. of water.
41. Sodium hydroxide, 20 percent	Dissolve 20 g. of sodium hydroxide in 100 mi. of water.
42. Sodium hydroxide, 2 Molar	Dissolve 8 g. of sodium hydroxide in water and dilute to 100 ml.
43. Sodium hydroxide, 1 Molar	Dissolve 4 g. of sodium hydroxide in water and dilute to 100 ml.
44. Sodium peroxide, 40 percent	Dissolve 40 g. of sodium peroxide in, 100 ml. of water.
45. Sodium thiosulfate	Dissolve 25 g. of sodium thiosulfate in 100 ml. of water.
46. Sulfuric acid, concentrated	Sp. gr. 1.84.
47. Sulfuric acid, 1:1	Add 50 mi. of concentrated sulfuric acid to 50 ml. of water.
48. Sulfuric acid, 20 percent	Add 20 ml. of concentrated sulfuric acid to 80 ml. of water.
49. Sulfurous acid, 6 percent *	Saturate 100 ml. of water at room temperature with sulfur dioxide.

Reagents-Salts

Table C4.T2. Reagents and Testing Solutions Continued

(Note: Use only freshly prepared solutions using distilled water as solute or solvent, as appropriate.)

Reagents-Salts

50. Ammonium persulfate
51. Potassium ethyl xanthogenate
52. Sodium bismuthate
53. Sodium fluoride
54. Sodium hydroxide
55. Sodium nitrate
56. Zinc oxide

* Use freshly prepared solution.

C4.9. LABORATORY ANALYSIS OF METALLIC SCRAP

C4.9.1. The following paragraphs describe more sophisticated spot testing procedures that can be used when the simplified procedures outlined in section C4.3., above, will not provide adequate identification of metallic scrap (particularly that which may have a high market value). It will seldom be necessary to follow every step in these procedures since a general familiarity with metals, and with the procedures outlined below, will enable qualified technicians to eliminate many materials from consideration before testing is begun. It must be emphasized that these procedures are qualitative only. Quantitative information must be obtained by more detailed spectrographic or chemical analyses.

C4.9.2. Table C4.T2. lists some reagents and testing solutions used in making chemical analyses of metallic scrap. Occasionally, one or more drops of the reagent will not provide a sufficient reaction to be detectable by visual examination. In these cases, use several drops, absorb the reaction products in a piece of filter paper, and then drop the identifying reagent on the filter paper; or, the sample may be dissolved by acid in a beaker and the reagent added to this solution.

C4.9.3. Before making chemical tests, clean the specimen with a degreasing solvent, stone wheel, emery cloth, sandpaper, or a file to remove dirt, grease, corrosion products, or any metallic plating or wash (e.g., zinc, tin, cadmium, nickel, chromium, gold, or silver).

C4.9.4. Known samples of materials may be tested simultaneously with the unknown to compare their behaviors under test conditions. To avoid errors resulting from the heat generated by some chemical reactions, samples less than 0.02 inch thick should always be placed on metal slab during testing.

C4.9.5. Test Procedures

C4.9.5.1. Tests for high-grade Bronze ("M" metal):

C4.9.5.1.1. High-grade bronze is a dark yellow metal of medium weight. It is nonmagnetic and non-sparking.

C4.9.5.1.2. Grind or file a clean surface on the sample.

C4.9.5.1.3. Apply one drop of 0.5 percent solution of silver nitrate to the freshly exposed surface.

C4.9.5.1.4. A clear color or a gray color slowly developing on the surface indicates "M" metal (high-grade bronze).

C4.9.5.2. Test for Red or Composition Brass.

C4.9.5.2.1. Red brass is a light yellow metal of medium weight. It is nonmagnetic and non-sparking.

C4.9.5.2.2. Grind or file a clean surface on the sample.

C4.9.5.2.3. Apply one drop of 0.5 percent solution of a silver nitrate to the freshly exposed surface.

C4.9.5.2.4. A spontaneous gray-black or black color developing on the surface indicates red or composition brass.

C4.9.5.3. Tests for Yellow Brass.

C4.9.5.3.1. Yellow brass is a light yellow metal of medium weight. It is nonmagnetic and non-sparking.

C4.9.5.3.2. File a niche in the metal or grind a clean surface. Yellow brass is identifiable by its yellow color.

C4.9.5.4. Tests for Manganese Bronze.

C4.9.5.4.1. Manganese bronze is a light yellow metal of medium weight. It is slightly magnetic but non-sparking.

C4.9.5.4.2. Manganese bronze shows the same yellow color in the freshly filed surface as yellow brass.

C4.9.5.4.3. Due to the high iron content in its alloy (about 31/2 percent), manganese bronze is easily separated from yellow brass by testing the filings. Magnetic filings from a light yellow metal indicate manganese bronze. The filings will congregate around the lines of force emanating from the magnet.

C4.9.5.5. Tests for Silicon Bronze and Aluminum Bronze.

C4.9.5.5.1. Silicon and aluminum bronzes are dark yellow metals of medium weight. Both metals are slightly magnetic and non-sparking.

C4.9.5.5.2. Silicon bronze will develop a reddish-yellow color on the surface of the casting due to its high copper content of 82 to 97 percent. A small sample of silicon bronze placed into a beaker containing concentrated nitric acid will, upon completion of the reaction, reveal a viscous or gelatinous substance remaining in the solution.

C4.9.5.5.3. Aluminum bronze has a light yellow color on its surface and a darker yellow color on the surface of a fresh cut. The freshly ground or cut surface of aluminum bronze will reveal a color similar to that of red brass instead of a yellow color as noted in manganese bronze. It is in the color of a freshly exposed surface that will be found the distinguishing characteristic that separates aluminum from manganese bronze since filings from both of these metals are attracted to themagnet. Aluminum bronze, unlike silicon bronze, does not develop a jellied mass when dissolved in a beaker of nitric acid.

C4.9.5.6. Tests for Monel, Nickel-silver (German-silver) or Cupro-nickel.

C4.9.5.6.1. These three metals belong to the copper-containing white metal group and are of medium weight. Grind or file a fresh surface to note if the metal is white. Do not allow these metals to become overheated from the grinding wheel. Heat accelerates their reaction to acids.

C4.9.5.6.2. Apply one drop of concentrated nitric-acid to a freshly ground surface. The more copper in the alloy, the faster the reaction will be to the acid, so that it is important to note the speed of the reaction as described below:

C4.9.5.6.2.1. Monel, regular, magnetic (70 percent nickel and 30 percent copper) and "K"Monel, non magnetic (64 percent nickel, 30 percent copper and 4 percent aluminum) will slowly develop a milky green color in solution.

C4.9.5.6.2.2. Nickel-silver, normally nonmagnetic (60 percent copper, 20 percent nickel and 20 percent zinc) will immediately develop a blue-green color in solution and give forth a puff of smoke due to the zinc content. Wash off the nitric acid with water and observe surface. If a copper or pink color develops on surface after rinsing in water, the sample is nickel-silver (German-silver).

C4.9.5.6.2.3. Cupro-Nickel, nonmagnetic, (70 percent copper, 30 percent nickel) rapidly develops a blue-green color in the solution due to a greater copper content than that of monel. Cupro-nickel does not develop a copper or pink color on its surface when rinsed with water and this helps to distinguish this alloy from the nickel-silvers (German-silver).

C4.9.5.6.3. Additional test methods for separating monel, nickel-silver, and cupro-nickel.

C4.9.5.6.3.1. Spark Test.

C4.9.5.6.3.1.1. Monel (regular or "K") imparts short red sparks in the carrier lines.

C4.9.5.6.3.1.2. Cupro-nickel imparts short red sparks in the carrier lines but pressure must be maintained against the grinding wheel in order to continue revealing sparks.

C4.9.5.6.3.1.3. Nickel-silver, normally, does not spark.

C4.9.5.6.3.2. Chemical Test.

C4.9.5.6.3.2.1. Apply one drop of concentrated nitric acid to freshly filed surface; if a green or blue-green color develops in the solution, note the speed of -reaction which will determine the likely copper content. These colors developing on a white metal from nitric acid indicate copper is contained in the alloy.

C4.9.5.6.3.2.2. Add one drop of hydrochloric acid to sample.

C4.9.5.6.3.2.3. Add one or two drops of Solution B. A red color developing in solution confirms the presence-oL-nickel and identifies the sample

as being a nickel-copper (Monel) or copper-nickel (cupro-nickel, nickel-silver) alloy since copper was confirmed by the nitric acid.

C4.9.5.7. Tests for Nickel.

C4.9.5.7.1. Nickel is white in color, of medium weight and strongly magnetic. Nickel imparts very short red sparks in the carrier lines when applied to a grinding wheel.

C4.9.5.7.2. File or grind a clean surface. Apply one drop of nitric acid to the clean surface. A pale green color developing very slowly in solution identifies a likelihood of nickel.

C4.9.5.7.3. To establish definite proof of nickel in conjunction with the magnet and spark tests, add one drop of hydrochloric acid to the nitric acid, then one or two drops of Solution B. A red color appearing in solution confirms nickel.

C4.9.5.8. Tests for Zinc.

C4.9.5.8.1. Zinc is a bluish-gray metal of medium weight. It is nonmagnetic and non-sparking.

C4.9.5.8.2. Zinc reacts vigorously in nitric acid evolving very acrid fumes and a brown color. A small sample or filings dropped into a Pyrex beaker containing nitric acid reacts violently, completely dissolving the sample or filings. There will be no precipitate remaining in solution.

C4.9.5.9. Tests for Tin.

C4.9.5.9.1. Tin is a white metal of medium weight. It is nonmagnetic and non-sparking.

C4.9.5.9.2. Tin filings also react vigorously in nitric acid with almost the same acrid fuming and brown color effect as zinc. Tin, however, does not dissolve in nitric acid, but forms a massive white spongy-looking precipitate in the beaker glass upon completion of the reaction.

C4.9.5.10. Tests for Magnesum.

C4.9.5.10.1. Magnesium is a white metal, very light in weight, and is nonmagneticand non-sparking. This metal is one-third lighter in weight than aluminum.

C4.9.5.10.2. Apply one drop of silver nitrate solution (0.5 percent) to a clean surface. A black spot immediately forming on the surface indicates material is magnesium.

C4.9.5.11. Tests for Aluminum.

C4.9.5.11.1. Aluminum is a white metal, light in weight, and is also nonmagnetic and non-sparking. This metal is two-thirds lighter in weight than steel.

C4.9.5.11.2. Apply one drop of silver nitrate solution (0.5 percent) to a clean surface. A clear spot remaining on the surface indicates material is aluminum.

C4.9.5.11.3. Aluminum with a copper content of 0.6 percent or more is known as Duralumin.

C4.9.5.12. Tests for Titanium.

C4.9.5.12.1. Titanium is a white metal, slightly heavier in weight than aluminum and about one half of the weight of steel.

C4.9.5.12.2. Titanium produces an unforgettable brilliant white stream of sparks when applied to the grinding wheel.

C4.9.5.13. Tests for High Temperature Alloys. [4]

C4.9.5.13.1. All high temperature alloys are white or gray in color.

C4.9.5.13.2. Except for titanium (a lightweight metal weighing about one-half the weight of steel, and tungsten and molybdenum, which are heavy metals), high temperature alloys are of medium weight.

C4.9.5.13.3. All high temperature alloys except type 446 stainless steel (23-26 percent chromium) are nonmagnetic.

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[4] For further information on high temperature alloys, see chapter 5, section C5.3.

C4.9.5.13.4. With the exceptions of titanium (which produces brilliant white spark streams), the 300 and 400 series stainless steels (which produce straw-colored spark streams 14 inches to 18 inches in length), and tungsten (which produces short yellow spark streams), all other high temperature alloys (including type 446 stainless steel) produce short red spark streams in varying lengths between 1-1/2 inches to 6 inches when applied to the grinding wheel.

C4.9.5.13.5. To test for presence of cobalt in high temperature alloys, apply one drop of concentrated sulfuric acid to a clean surface area. There will be no reaction to the nitric acid. Then, add one drop of concentrated hydrochloric acid to the nitric acid. A blue color developing by itself or within a pea-green color in the solution identifies the presence of cobalt. If the pea-green color develops alone in the solution, cobalt is not present, therefore, test for inconel/hastelloy or type 310 stainless steel. (See procedures in subparagraph C4.9.5.13.7.,below.)

C4.9.5.13.6. Chemical spot testing to separate high temperature alloys containing nickel with cobalt from alloys containing nickel with no cobalt.

C4.9.5.13.6.1. Clean surface of the sample.

C4.9.5.13.6.2. Apply nitric acid.

C4.9.5.13.6.3. Add hydrochloric acid.

C4.9.5.13.6.4. A blue (turquoise) color appearing in the solution indicates cobalt is present in the alloy(if pea-green only, proceed to subparagraph C4.9.5.13.6.5., below). Next add Solution B (which is a test for nickel) to determine the comparative quantity of nickel in an alloy. A deep red color indicates high nickel content and low cobalt content. A pink or faint red color indicates low nickel content and high cobalt content.

C4.9.5.13.6.5. A pea-green color indicates that the alloy does not contain cobalt. Next add potassium ferricyanide (which is a test for iron). A brown color indicates an alloy with low iron content and high nickel content (e.g., type 310 or 314 stainless steel, Timken 16-25-6, Incoloy, other alloys that have a higher nickel content than the 300 series stainless steel group).

C4.9.5.13.7. To distinguish Inconel and/or hastelloy from type 310 stainless steel:

C4.9.5.13.7.1. Upon determining from the "test for cobalt" that the stainless steel or high temperature alloy contains no cobalt, add a few drops of potassium ferricyanide solution (10 percent) to the nitric and hydrochloric acid already on the sample and observe.

C4.9.5.13.7.2. A brown color developing in solution indicates low iron; therefore, Inconel or hastelloy.

C4.9.5.13.7.3. A blue or blue-black color developing in solution indicates high iron; therefore, type 310 stainless steel. The 300 series stainless steels also develop these colors, but they are readily separated from type 310 stainless steel by the spark test. Spark streams from type 310 are approximately 6 inches in length, whereas other 300 series spark streams are 12 to 18 inches in length.

C4.9.5.13.8. To distinguish high cobalt alloys from low cobalt alloys:

C4.9.5.13.8.1. Upon determining from the "test for cobalt" that the alloy contains cobalt, add a few drops of Solution B to the nitric and hydrochloric acid already on the sample and observe.

C4.9.5.13.8.2. A faint or pale pink color developing in the solution indicates low nickel and therefore high cobalt.

C4.9.5.13.8.3. An extensive red color developing in the solution indicates high nickel and therefore low cobalt.

C4.9.5.14. Tests for-gold or gold-plated metals.

C4.9.5.14.1. Gold is a yellow metal and very heavy. It is usually plated on medium weight metals such as steel, nickel or copper-base alloys; but it mayalso be plated on lightweight metals such as aluminum.

C4.9.5.14.2. Gold is a nonmagnetic and non-sparking metal.

C4.9.5.14.3. Nitric acid has no effect or gold or gold-plated metals.

C4.9.5.14.4. To identify the base metal in a gold-plated sample, file a small niche in it and apply a drop of nitric acid. If the nitric acid attacks the base metal and a green color appears in solution, it indicates a copper-base alloy. In the event that gold has been plated on a high-value metal, suchas nickel for example, the total value of the nickel might be much greater than that of the gold plating.

C4.9.5.14.5. To test for the presence of gold, complete the following test:

C4.9.5.14.5.1. Clean the surface to be tested of any dirt, grease, or other organic surface coatings. There must be direct contact between the metal and reagents, otherwise reaction will not take place.

C4.9.5.14.5.2. Gold is soluable in Aqua Regia (AR), which is 3 parts hydrochloric acid and 1 part nitric acid. Add AR to the surface and wait for a reaction. Before the AR penetrates the gold and starts attacking the base metal, add 3 drops of water. (The solution only has to be slightly acidic, but at the same time has to have enough gold to provide an adequate test.)

C4.9.5.14.5.3. Pick up some of the solution on a strip of filter paper and on the zone of the contact add 2 drops of Stannous Chloride ($SnCI_2$). If pinkish red color develops then plating is gold. Caution: Some red colored anodized aluminum, when acted upon by HCI or AR, may have the red dye dissolve. Don't mistake it for gold.

C4.9.5.15. Test for silver or silver-plated metals.

C4.9.5.15.1. Silver is a white, heavyweight metal. It is unsually plated on medium or lightweight metals.

C4.9.5.15.2. Silver is a nonmagnetic and non-sparking metal.

C4.9.5.15.3. Place one drop of nitric acid on the sample, then add one drop of hydrochloric acid. A milky white flash forming immediately in the solution, or a white precipitate (similar to fresh fallen snow) forming on the sample, indicates that the metal is silver or silver-plated.

C4.9.5.15.4. An alternative method of indentitying silver is as follows:

C4.9.5.15.4.1. Add 1 drop of nitric acid to the clean surface and then dilute with 2 drops of water. Add 1 drop of potassium chromate (K_2CrO_4) or potassium dichromate ($K_2Cr_2O_7$) and a red preciitate or blood-like coloration will form indicating silver.

C4.9.5.15.4.2. For fine silver adding a drop of silver nitrate ($AgNO_3$) will cause no reaction. If the silver is alloyed with copper, the reagent will leave a dark spot. The more copper in the alloy, the darker the spot.

C4.9.5.16. In addition to the above methods in identifying metals and alloys, other methods used for making a preliminary identijfication, principally by dealers specializing in specific grades or types, include the following:

C4.9.5.16.1. Naval Bronze. Using an electric drill, obtain a pigtail turning from its drillings. The inner surface of the turning will reveal a reddish color. The turning breaks apart readily when pulled.

C4.9.5.16.2. 70/30 Brass. Using an electric drill, obtain a pigtail turning from its drillings. The inner surface of the turning will reveal a yellowish color. The turning breaks apart readily when pulled.

C4.9.5.16.3. Silicon Bronze. Using an electric drill, obtain a pigtail turning from its drillings. The turning does not break apart readily when pulled, but feels springy.

C4.9.5.16.4. Muntz Metal Tube. Fractured (not cut) end reveals a brownish color in its break.

C4.9.5.16.5. Admiralty Metal Tube. Fractured (not cut) end reveals a greenish color in its break.

C4.9.5.16.6. Beryllium Copper. Heat sample to a cherry red pitch just below its melting point, then immerse in cold water. Beryllium copper retains its original surface color after cooling, whereas other copper-base alloys develop a red color on their surface.

C4.9.5.16.7. Platinum and Other Precious Metals. Heat sample until white hot, allow it to cool under normal conditions. Platinum or a high platinum alloy will retain its original surface color after cooling, whereas other white or steel-gray precious metals will become dark or black.

C4.9.5.16.8. Aluminum. Draw a sharp knife along an edge of the sample. Aluminum is a soft metal and will peel into a pigtail turning with the movement of the knife.

C4.9.5.16.9. Magnesium. Draw a sharp knife along an edge of the sample. Magnesium chips and breaks off with the movement of the knife. Also, magnesium filings burn with a hot, white light when ignited.

C4.9.6. Test Procedure Charts. The following charts provide step-by-step guidance for identification of metals and alloys. Figure C4.F4. applies to very heavy metals; Figure C4.F5. to heavy metals; Figure C4.F6. to light metals and alloys; FigureC4.F7. to copper and copper alloys; and Figures C4.F8. through Figures C4.F14. apply to ferrous and nonferrous metals and alloys.

C4.9.7. Metal Identification Tables. Table C4.T3. references various identification tests and end use applications of specific ferrous and nonferrous metals. Table C4.T4. lists chemical symbols of metals. Table C4.T5. explains spark test results on some common metals and Table C4.T6. summarizes the basic testing methods (visual, magnetic, spark, and chemical) used in metals identification.

Table C4.T3. Identification of Metals

The Department of Defense recognizes the complexities involved in the identification and proper segregation of metals and has established a program to help solve the problem. The proper segregation and classification of metals is of prime importance both to the Government and the purchaser. Sorting is the segregation of metals into proper groups of classifications, prior to offering for sale. Metals should be properly segregated with various objectives in mind, such as:

(1) Increases customer value of scrap metals.

(2) Increases the monetary value of scrap metals.

(3) Failure to remove offgrade reduces the monetary value of prime materials.

(4) Decreases cost of quality control in the manufacture of industrial products.

(5) Allows reuse of minerals which might otherwise be lost during smelting.

(6) Saves important natural resources for future generations.

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Aluminum	Light gray	Nonmagnetic	Soluble	White reaction	A1, 99.9+	Aircraft, kitchenware and machine castings.
Aloca 2S	do	do	do	do	A1, 99+	Containers, tanks, auto body parts.
Aloca 3S	do	do	do	do	A1, 98+	Structural work, tank cars, pipes, storage containers.
Aloca 24S	Dark gray	do	do	do	Mn, 0.8; Si, 0.8; Cu, 4.5; A1, balance.	Aircraft structure, wings, pontoons.
Aloca 62S	do	do	do	do	Cu, 0.04; Si,0.08; Mg, 1.2; A1, balance.	Marine applications
Aloca 75S	Dark gray	Nonmagnetic	Soluble	White reaction	Cu, 1.6; Cr, 0.3; Mg, 0.2; A1, balance.	Light alloy parts, aircraft.
Aloca 112	do	do	do	do	Cu, 7; Zn, 1.7; Fe, 1.5; Si, 1; A1, balance.	Crank cases, oil pans, motor housing, vacuum sweeper parts, Pistons, valve guides, cam shaft bearings.
Gilding, 95 percent	Dark Red	Do	Green	Dark blue	Cu, 95; Zn, 5	Bullet jackets, firing pin support shells, fuze caps, primers.
Gilding 90-10	Do	Do	Do	Do	Cu, 90; Zn, 10	Screen cloth, weather stripping, kick plates, line clamps, marine hardware, rivets, screws, screw shells, primer caps, ornamental trim and screen wire.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Red brass	Pinkish-white	do	do	do	Cu, 85; Zn, 15	Fire extinguishers, electric sockets, plumbing pipe, pump lines, radiator cores, faucets.
Red casting brass, 85-5-5-5.	do	do	do	do	Cu, 85; Sn, 5; Ph, 5; Zn, 5	Castings and hardware.
Red brass, 80-10-10	do	do	do	Light blue	Cu, 80; Sn, 10; Pb, 10	Bushings, bearings, high compression.
Red brass, 88-10-2	do	do	do	Dark blue	Cu, 88; Sn, 10; Zn, 20	Pipe lines and fittings, General machinery, contraction of gears.
18-8 alloy, type 300 stainless	Bright	do	No reaction	No reaction	Ni, 11.0 max; Cr, 20.0 max; Fe, balance.	All stainless steel applications, to include food-dairy-oil-chemical industries.
Mu-Metal	Gray	Magnetic	Pale green	Light blue	Ni, 75; Cu, 6; Cr, 2; Fe, balance.	Audio transformers, sensitive relays.
Nickel steel, 50 percent	Bright	do	No reaction	No reaction	Ni, 50 max; Fe, balance	Floor plates, reflectors, hardware, staplings.
Nickel steel, 30 percent	do	do	do	do	Ni, 30; Fe, balance	Floor plates, reflectors, hardware, staplings.
Projectile steel	Dark gray	do	do	Do	Cr, 2.4; 0.8; Mn, 0.4; Si, 0.2; Fe, balance.	Artillery projectiles.
Aluminum steel	Light gray	do	do	do	Cr, 1.15; Mn, 0.5; Si, 0.25; C, 0.25; Fe, balance.	Structural parts.
Tungsten	Bright	Nonmagnetic	No reaction	No reaction	W, 99.0 min	Welding electrodes and electronic parts.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Gray cast iron	Dull gray	Magnetic	Brown	Red Brown	C, 3.5 max; Si, 0.8 min; Fe, balance.	Plumbing, hardware, fittings, pipes, radiators, boiler jackets, motor blocks.
Cast iron, malleable	do	do	do	do	C, 2.5 max; Mn, 0.35; S, 0.1; Si, 1.2; Fe, balance.	Railway and automotive castings.
Low brass	Yellow to Pink	Nonmagnetic	Green	Dark blue	Cu, 80; Zn, 20	Battery caps, ornamental metal work, bellows, musical instruments, flexible hose, pump line.
Cartridge brass	Light yellow	do	do	do	Cu, 70; Zn, 30	Radiator cores, and tanks, lamp fixtures, socket shells, ammunition components, plumbing brass goods.
Yellow brass	Yellow	do	Light green	do	Cu, 65; Zn, 35	Lamp fixtures, flashlight shells, reflectors, bead chain, kick plates, locks, plumbing accessories, sink strainers.
Muntz metal	do	do	Green	do	CU, 60; Zn, 40	Large nuts & bolts, brazing rod, condenser plates, condensers, evaporator and heat exchanger tubes.
Leaded commercial bronze	Orange-yellow	do	Light green	Light blue	Cu, 89; Pb, 1.75; Zn, 9.25	Hardware, fittings, screws, nuts and bolts.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Medium leaded brass	Yellow	do	do	do	Cu, 65; Zn, 34; Pb, 1	Butts, gears, nuts, rivets, screw dials, engravings and instrument plates.
High leaded brass	do	do	do	do	Cu, 66; Pb, 1.6; Zn, 33	Channel plate, clock plates and nuts, clock gears and wheels, telescope secondary items.
Free cutting brass	do	do	do	do	Cu, 61.5; Pb, 3; Zn, 35.5	Gears, pinions, automatic high speed screw machine parts and accessories.
Leaded muntz metal	Light yellow	do	Dark green	Dark blue	Cu, 60; Pb, 0.6; Zn, 39.4	Condenser tube plates.
Admiralty brass	do	do	Green	do	Cu, 70; Sn, 1; Zn, 29	Condenser, evaporator and heat exchange tubes, condenser tube plates, distiller tubes, ferrules.
Naval brass	Dark yellow	Nonmagnetic	Green	Dark blue	Cu, 60; Sn, 0.75; Zn, 39.25	Aircraft turnbuckle barrels, balls, bolts, marine hardware, nuts, propeller shafts, rivets, structural uses, valve stems.
Leaded naval brass	do	do	do	do	Cu, 60; Sn, 0.75; Pb, 1.75; Zn, 37.5.	Marine hardware, screw machine products, valve stems.
Manganese bronze	Bright yellow	Slightly	do	do	Cu, 58.5; Sn, 1; Fe, 1.4; Mn, 0.1; Zn, 39.	Automotive clutch disks, pump rods, shafting balls, valve stems and bodies.
Aluminum brass	Light-yellow	Nonmagnetic	Dark green	Light blue	Cu, 76; Al, 2; Zn, 22	Bushings, gears and general hardware.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Phosphor bronze, 5 percent.	Dark red	do	Blue-green	Dark blue	Cu, 95; Sn, 5	Beater bars, bellows, tubing clutch disks, cotter pins, fuse clips, lock washers, truss wire, wire brushes.
Phosphor bronze, 1.25 percent.	do	do	do	do	Cu, 98.75; Sn, 1.25; P, trace.	Electrical contacts, flexible hose, pole-line hardware.
Phosphor bronze, free-cutting.	Light red	do	do	do	Cu, 88; Pb, 4; Zn, 3.5+	Bearings, bushings, gears, pinions, shafts, thrust washers, valve parts.
High-silicon bronze	Red-yellow	do	Light gray	Light blue	Cu, 96; Si, 3	Propeller shafts, bearing plates, bushings, kettles, piston rings, marine hardware, screen cloth and wire.
Low-silicon bronze	do	do	do	do	U, 97.5; Si, 1.5.	Anchor screws, bolts, cable clamps, machine screws, marine hardware, U-bolts, electrical conduits, welding rod.
Cupro-nickel, 70-30	Light gray	do	Blue-green	Blue	Cu, 70; Ni, 30	Condensers, condenser plates, distiller tubes, evaporator and heat exchanger tubes, ferrules, salt water piping.
Cupro-nickel, 80-20	Tan-Pink	do	do	do	Cu, 80; Ni, 20	Condenser tubes, heat exchanger tubes.
Cupro-nickel, 90-10	Tan Pink	Slightly	Blue-green	Blue	Cu, 88.7; Fe, 1.3; Ni, 10	Condensers, condenser plates, distiller tubes, evaporator and heat exchanger tubes, ferrules, salt water piping.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Nickel-silver, 65-18	Gray to yellow	Slightly to nonmagnetic.	Bluish-green	Dark blue	Cu, 65; Ni, 18; Zn, 17	Rivets, screws, table flatware, truss wire, zippers, camera parts, radio dials.
Copper, electrolytic	Red	Nonmagnetic	Blue-green	do	Cu, 99.9	Electric conductors, pipes, electronic parts.
Copper, oxygen-free, H.C.	do	do	do	do	Cu, 99.99	Wire, conductors, switches, electronic accessories.
Copper, phosphor	do	do	do	do	Cu, 99.9; R, 0.1	Bearings and machine castings.
Copper, tough pitch	do	do	do	do	CU, 99.9; O, 0.1	Gaskets, radiators, radio and television parts, electric switches, gutters, roofing, screening and downspouts.
D-nickel	do	do	do	Light blue	Ni, 94; Mi, 4.5	Spark plug wires and welding rods.
Z-nickel	Light gray	do	do	Dark blue	Ni, 94; Al, 4.5	Corrosion-resistant springs.
Monel	Dark gray	Slightly	Greenish-blue	do	Cu, 31.25; Ni, 65.5; Fe, 1	Table tops, kitchen equipment.
K-Monel	Light gray	Nonmagnetic	Green	Blue	Ni, 64;Cu, 30; Fe, 1; Mn, 1; Al, 4	Springs, nonmagnetic parts, pump rods, check valves, marine parts.
S-Monel	do	Slightly	do	Light blue	Ni, 63; Cu, 30; Fe, 2; Si, 4	Machine castings, airplane parts, marine parts.
Inconel	Dark gray	Nonmagnetic	No reaction	No reaction	Ni, 76; Cr, 155.5; C, 0.0.4; Fe, 7	Dairy equipment, food handling equipment, airplace exhaust manifolds, cooking equipment.
Inconel X	Light gray	do	do	do	Ni, 73; Cr, 15; C, 0.04; Ti, 2.50; Fe, 7; Al, 0.9	Combustion chambers on jet engines, electronic equipment and springs.
Inconel W	do	do	do	do	Ni, 75; Cr, 15; C, 0.04; Ti, 2.50; 7; Al, 0.6	High temperature applications, principally used in jet engines.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Nichrome	Bright	Slight/strong	No reaction	No reaction	Ni, 60; Cr, 15; Fe, balance	Heat treating fixtures and resistance wire.
35-15 alloy, type 330 stainless	do	do	do	do	Ni, 35; Cr, 15; Fe, balance	Heat treating fixtures, enameling racks.
25-20 alloy, type 310 stainless	do	Nonmagnetic	do	do	Ni, 20; Cr,25; Fe, balance	Heat and corrosion resistant parts.
25-12 alloy, type 309 stainless	do	do	do	do	Ni, 12; Cr, 25; Fe, balance	Heat treating fixtures and jet engine parts. Annealing boxes, furnace conveyors, furnace linings, air preheaters.
Nickel cast iron	Bright gray	Magnetic	Light brown	Dark red	Ni, 3; Si, 1.5; Cr, 1; Fe, balance	Cast gears.
Carbon steel	Dark gray	do	Brown	Red-brown	C, 1.4; Fe, balance	High speed tools cutters, tools, drills, taps.
Chromium steel	Light gray	do	Brown-black	Brown-green	C, 0.15; Mn, 0.5; Si, 0.5; Cr, 6; Mo, 0.65; Fe, balance	Hot oil piping, high temperature steam pipes.
Manganese steel	Dark gray	Nonmagnetic	Black	Light-dark	Mn, 12; Si, 0.65; C, 1.2.	Perforated screens, dipper teeth, journal-box liners, wear plates, screen, rails.
Tungsten carbide	Gray	Slight/strong	No reaction	No reaction	Ni, various; Co, various	Welding electrodes and electronic parts; projectile cores, cutting tool tips.

Table C4.T3. Identification of Metals, continued

Metal	Color	Magnet test	Nitric-acid test	Ammonia test	Normal composition, percent	Typical uses
Molybdenum	Silver-white	Nonmagnetic	Olive brown	Dark brown	Mo, 99; min.	Grids, hooks, and support members in radio and light bulbs, welding electrodes.
18-4-1- tool steel	Light gray	Magnetic	None	None	W, 18; Cr, 4; C, 1; Fe, balance	Cutting tools.
Molybdenum steel	Dark gray	do	Brow-black	Red-brown	Cr, 1.1; Mo, 0.40.; C, 0.30; Mn, 0.7; Fe, balance	Crankshafts, connecting rods, Steering knuckles, propeller shafts, front axles, bolts, crank pins and piston rods.
Vanadium steel	do	do	do	do	V, 14.0; C, 1.3; Plus Si, P&S; Fe, balance	Machinery parts, tools, dies, gears.
Magnesium alloys	Light gray	Nonmagnetic	No reaction	No reaction	Al, 3.5; Zn, 1.5; Mg, balance	Light alloy parts, airplane wheels, rockets.
Lead, antimonial	White-gray	do	do	do	Sb, up to 25.0; Pb, balance	Storage battery plates, fuses, bullets, pipes, plumbing accessories.
Lead, No. 1 hard	Gray	Nonmagnetic	No reaction	No reaction	Pb, 99.25; Cd, 0.25; Sb, 0.5	Valves, cocks, cable sheathing, tank linings.
Zinc	Bluish-white	do	Vigorous reaction-brown smoke.	do	Zn, 99.95	Galvanizing iron and steel, and in electric batteries; also used in sheet or corrugated-sheet form for roofing and siding in building construction.

Table C4.T4. Common Chemical Symbols Used In the Metal Industry

Name	Symbol	Name	Symbol
Aluminum	Al	Manganese	Mn
Antimony [1]	Sb	Mercury [6]	Hg
Barium	Ba	Molybdenum	Mo
Beryllium	Be	Nickel	Ni
Bismuth	Bi	Osmium	Os
Boron	B	Palladium	Pd
Cadmium	Cd	Platinum	Pt
Calcium	Ca	Radium	Ra
Carbon	C	Rhodium	Rh
Chlorine	Cl	Ruthenium	Ru
Chromium	Cr	Selenium	Se
Cobalt	Co	Silicon	Si
Columbium [2]	Cb	Silver [7]	Ag
Copper	Cu	Sodium [8]	Na
Gallium	Ga	Sulphur	S
Germanium	Ge	Tantalum	Ta
Gold [3]	Au	Tin [9]	Sn
Iridium	IR	Titanium	Ti
Iron [4]	Fe	Tungsten [10]	W
Lead [5]	Pb	Uranium	U
Lithium	Li	Zinc	Zn
Magnesium	Mg	Zirconium	ZR

1 Antimony--Stibium.

2 Columbium--Also know as Niobium.

3 Gold--Aurium.

4 Iron--Ferrum.

5 Lead--Plumbum.

6 Mercury--Hydrargyrum.

7 Silver--Argentum.

8 Sodium--Natrium.

9 Tin--Stannum.

10 Tungsten--Wolfram.

Table C4.T5. Spark Testing of Some Common Metals

Name	Spark test	Name	Spark test
Nickel	Coarse red	Chrome Steel or 400 Series Stainless Steel	Very light and diffused.
D-nickel	Do.		
Z-nickel	Do.	Mu-Metal	Coarse red
Monel	Do.	Nickel Steel 5--50%	Orange-red white ends.
K-Monel	Do.	Nickel Steel--30%	Yellow white ends.
S-Monel	Do.	Pure Cobalt.	Coarse red.
Cupro-nickel	Do.	Cast alloy tool steel (stellite, etc.)	Fine dark red.
Nickel silver	None.		
Inconel, inconel X and inconel	Very dark red.	Tungsten	Short yellow-white.
W, nimonic 75 and 80		Tungsten carbide	Do.
Nichrome	Fine orange-red.	Molybdenum	Short yellow-orange.
35-15 alloy or type 330	Coarse orange-red.	18-4-1 or T-1 tool steel	Dark red fire balls.
stainless steel		6-6-2 or M-2 tool steel	Orange burst, white ends.
25-20 alloy or type 310	Fine orange-red turning white.	M-1 tool steel	Yellow burst, white ends.
stainless steel		Titanium	Brilliant White.
25-12 alloy or type 309 stainless steel	Coarse light orange turning white.		
18-8 type 300 series stainless steel.	Light and diffused.		

Table C4.T6. Summary of Testing Procedures

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
No. 1 Heavy Copper, Clean, min. 1/16" thick.	Red	99.9 Cu	No	None	None--Color alone is identification method.
Mixed Heavy Copper. Coated or soldered.	Red	99.9 Cu	No	None	Do.
No. 1 Copper Wire, Clean, uncoated, min. 16 ga. thick	Red	99.9 Cu	No	None	Do.
No. 2 Copper Wire. Coated or soldered.	Red	99.9 Cu	No	None	Do.
Light Copper. Less than 1/16" thick.	Red	99.9 Cu	No	None	Do.
Insulated Copper Wire. Rubber, fabric, plastic covered.	Red	99.9 Cu	No	None	Do.
Composition or Red Brass Solids	Pink-White, Smokey, Hazy.	86 Cu, 5 Sn, 5Pb, 5ZN, (Nominal)	No	None	To be used only to separate from ghigh grade bronze: Silver nitrate will produce a black color in solution.
Yellow Brass Solids	Golden-Yellow	65 Cu, 35 Za, (Nominal)	No	None	None, color alone is identification method, soft as compared to manganese bronze.
Red Brass Pipe	Pink-White, Smokey, Hazy	85 Cu, 15 Zn, (Nominal)	No	None	None, color alone, when compared with yellow brass pipe, is identification method.
Yellow Brass Pipe	Golden-Yellow	70 Cu, 30 Zn, (Nominal)	No	None	None, color alone, when compared with red brass pipe, is identification method.
High Grade Bronze, (M Metal)	Pink-White, Smokey, Hazy	88 Cu, 10 Sn, 2 Zn, (Nominal)	No	None	To be used only to separate from composition or red brass. Silver nitrate will produce clear or gray color in solution.
Manganese Bronze	Golden-Yellow	58 Cu, 39 Zn, 3 Fe, (Nominal)	Slightly, filings on paper more evident	None	None, hard, brittle and coarse when compared to yellow brass.

C4.T6. Summary of Testing Procedures, continued

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
Cupro-nickel 70/30	Light Gray	70 Cu, 30 Ni	No	Short red if hard pressure applied to grinding wheel.	Nitric acid will produce a spontaneous green color of copper. Add hydrochloride acid and solution "B," which will produce the red color indicating nickel. Avoid heating specimen.
Cupro-nickel 90/10	Light-Brown	90 Cu, 10 Ni	Non-magnetic to slightly magnetic	None	Same as above.
Nickel Silver	Gray to slightly Yellow	60 Cu, 20 Zn, 20 Ni, (No fixed composition)	No to slightly	None	Nitric acid will produce a spontaneous green color and vigorous reaction and an *immediate* puff of brown smoke. Specimen will develop a pink color after acid is washed off with water.
Silver Plated	Light-Gray	99.9 Ag in Plating Only	No, unless base metal is steel or pure nickel.	None	Nitric acid and hydrochloric acied will produce a milky-white precipitate in the solution on the plated surface. After removing plating, if base metal is a copper base alloy, nitric acid will turn green. If base metal is aluminum, the specimen will be light in weight. If base metal is steel, the specimen will be magnetic.
Silver	Light-Gray	99.9 Ag	No	None	Place small portion of specimen in glass beaker containing nitric acid, permit some of the specimen to dissolve. Remove specimen and add hydrochloric acid. A white precipitate or snowy white color forming immediately in the solution indicates silver. First ascertain that material is uniform throughout. For silver plate on different base metal see procedures outlined above.

C4.T6. Summary of Testing Procedures., continued

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
Gold plated	Yellow	99.9 Au in plating only	No, unless base metal is steel or pure nickel	None	Nitric acid will have no effect on gold plated surface. After removing plating, if base metal is a copper base allow, nitric acid will turn green. If base metal is aluminum the specimen will be light in weight. If base metal is steel the specimen will be magnetic. If specimen is very heavy suspect heavy gold plating or solid gold.
Gold	Yellow	99.9 Au	No	None	Nitric acid will have no effect on gold. First ascertain that material is uniform throughout. For gold plate on different base metal, see procedure outlined above.
Aluminum	Light-Gray	99.9 Au and variations	No	None	Silver nitrate will remain clear in solution.
Magnesium	Light-Gray	90 Mg, 3/6 Al, 1/2 Zn (Nominal)	No	None	Silver nitrate will produce a dark gray to black color in solution. Filings will burn like a flare.
Lead	Dark-Gray	99.9 Pb and variations.	No	None	None
Zinc	Bluish-Gray	99.9 Zn and variations	No	None	Nitric acis applied to filings will produce effervescent and spontaneous brown smoke. Solution will remain clear with no precipitation.
Tin	White	99.9 Sn	No	None	Nitric acid applied to filings will produce a yellow smoke and yellow color on surface or solution, good amount of white precipitations will remain in solution.
Kirksite and Zinc Die Cast	Bluish-White	98 Zn, 2/4 Cu, 4/5 Al and variations.	No	None	Nitric acid applied to fillings will produce a spontaneous light brown smoke similar to, but lighter than zinc. Solution will appear greenish with no precipitation.

C4.T6. Summary of Testing Procedures., continued

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
Monel (Except Monel "K")	Light-Gray	70 Ni, 30 Cu, (Nominal)	Slightly	Very short dark red.	Nitric acid will produce a delayed milky green color. Avoid heating specimen.
Titanium	Light-Gray	80 Ti, min., (Nominal)	No	Brilliant white spark 12" to 18" long with star and shell bursts.	None.
Monel "K"	Light-Gray	64 Ni, 30 Cu, 4 Al, (Nominal)	No	Very short dark red.	Same as Monel.
Nickel	Light-Gray	99.9 Ni	Strongly	Very Short dark red.	Nitric acid will slowly develop a clear pale green color in the solution. Add hydrochloride acid and Solution "B" to develop the red color indicating nickel.
300 Series Stainless Steel, AF Group No. 1.	Light-Gray	17/19 Cr, 7/9 Ni, bal. Fe (Nominal)	No, except stamping, forming, bending and cold working create slight magnetic properties.	Not as dense or profuse as carbon steel. Orange to straw colored sparks, which travel completely around the grinding wheel ending in a straight line 12" to 18" long without starbursts.	Nitric acid will produce no reaction. Add hydrochloric acid, which will produce a pea green color. Add Solution "B" to develop the red color indicating nickel. Add potassium ferricyanide, which will produce a blue-black color indicating high iron content. Note: Types 310, 314, and 330 stainless steel will react exactly the same. However, the spark characteristics are different.
310 Series Stainless Steel, AF Group No. 14	Light-Gray	25 Cr, 20 Ni, bal. Fe	No	Short red turning orange. Sparks are approx. 6" long and do not travel around the grinding wheel. No starbursts in carrier lines.	Same test as above for 300 series Stainless Steel will produce the same results. However, the spark test will separate one from the other.

C4.T6. Summary of Testing Procedures., continued

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
400 Series Stainless Steel, AF Group No. 2.	Light-Gray	11/18 Cr, bal. Fe	Strongly	Not as dense or profuse as carbon steel. Orange to straw colored and travel completely around the grinding wheel. Sparks are 14" to 18" long and end with the appearance of a split tongue burst.	None.
Inconel, Inconel X, Inconel W, Nimonic 75 and 80, AF Groups No. 8 and No. 16.	Light-Gray	14/20 Cr, 73/77 Ni, bal. Fe	No	Very short red 1 1/2' to 2" long and travel around the grinding wheel.	Nitric acid will produce no reaction. Add hydrochloric acid which will then produce a pea green color. Add Solutions "B" to develop the red color indicating nickel. Add potassium ferricyanide, which will then produce a brown color indicating low iron content.

C4.T6. Summary of Testing Procedures., continued

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
Hastalloly--"C" AF Group No. 4	Light-Gray	16 Cr, 57 Ni, 17 Mo, 4 W, bal. Fe	No	Very short red 1 1/2" to 2" long and do not travel around the grinding wheel.	Same as Inconel and Nimonic Af Groups No. 8 and No. 16. Reaction will be exactly the same. Note: Hastalloay "C" Inconel and Nimonic 75 and 80 cannot be identified one from the other by spot testing. Lacking further identification by chemical or spectrographic analysis description should be as follows: "Inconel, Nimonic 75 and 80 and/or hastalloy."
Low Cobalt--High Nickel, Af Groups No. 18 and No. 28, Waspalloy and Thetaloy (Nickel Base-Cobalt Bearing)	Light-Gray	19/25/ Cr, 55/60 Ni, 12/13 Co.	No	Very short red 1 1/2" to 2" long and do not travel around the grinding wheel.	Nitric acid and hydrochloric acid will develop a blue (turqoise) color indicaing cobalt. Add Solution "B" to develop deep red color indicating a high nickel content. Apale ponk color indicates a low nickel content, which in turn means a higher cobalt content.

C4.T6. Summary of Testing Procedures., continued

Material	Color	Principal Elements	Magnetic	Spark Test	Chemical Spot Test
High Cobalt--Low Nickel, AF Groups No. 3, No., 9, and No. 15 (Cobalt Base--Nickel bearing)	Light-Gray	12/27 Cr, 1/20 Ni, 40/67 Co.	No	Very short red 1 1/2" to 2" long and do not travel around the grinding wheel.	Same a Low Cobalt--High Nickel, AF Groups No. 18 and No. 28.
Armor Plate and Low Alloy Steel containing Nickel.	Gray	1% to 5% Ni, bal. Fe	Same as normal carbon steel. Sparks are dense and long, travel completely around the grinding wheel, generally white to straw colored with bursts throughout the carrier lines.	Apply Solution "A" and let it react for 30 seconds. Blot with white blotting paper, add Solution "B" in blotter. A very deep red color indicates a nickel content of 3% to 5%. A pink color indicates a nickel content of 1% to 2%.	Apply Solution "A" and let it react for 30 seconds Blot with white blotting paper, add Solution "B" on blotter A very deep red color indicates a nickel content of 3% to 5%. A pink color indicates a nickel content of 1% to 2%.

C5. CHAPTER 5

SCRAP YARD SPECIFICATIONS

C5.1. GENERAL

C5.1.1. This chapter summarizes the commercial specifications used by the scrap recycling industry to describe the types/grades of scrap generally handled in DoD scrap yards. Also included are descriptions of several typical categories of unprepared scrap, which deviate from recycling industry standards.

C5.1.2. Whenever feasible, scrap received in DoD scrap yards should be segregated and described in accordance with commercial scrap specifications, because this will enable prospective buyers to submit competitive bids at or near commercial market prices without incurring the substantial costs that would otherwise be involved in making physical inspections. Where use of commercial specifications is not feasible (e.g., in describing ordnance scrap consisting of demilitarized artillery projectiles/missiles, bombs, mines or torpedoes) scrap should be identified as such and further described by listing the National Stock Number (NSN) of the property from which the scrap was derived and the relative proportions of its constituent elements, including any contaminants.

C5.1.3. Many of the constituent elements of nonferrous scrap (including scrap that contains stainless steel and high temperature alloys) are classified as critical and strategic materials because of the lack of an adequate domestic supply of these materials (especially for aerospace applications) and our current foreign sources of supply. It is therefore essential, as previously indicated in Chapter 1, that we place priority emphasis on recovering these materials, particularly cobalt, titanium, chromium, and rare precious metals, from the DoD scrap stream and describing them accurately for sale to the recycling industry. In this way, we can significantly reduce our dependence on foreign sources of supply. (See Table C5.T1. for a graphical presentation of U.S. net import reliance on selected minerals and metals.)

C5.2. FERROUS SCRAP

C5.2.1. General Requirements

C5.2.1.1. Cleanliness. All grades of ferrous scrap will be free of dirt, nonferrous metals, or foreign material of any kind, and excessive rust and corrosion. However, the phrase "free of dirt, nonferrous metals or foreign material of any kind" is

not intended to preclude the presence of negligible contamination where it can be shown that this is unavoidable in the customary preparation and handling of the particular grade involved.

C5.2.1.2. Off-grade material. Inclusionof a negligible amount of metallic material that exceeds to a minor extent the size limitations or fails to a minor extent to meet applicable quality requirements for that grade. Such minor deviations will not change the classification of the lot, provided it can be shown that inclusion of such off-grade material is unavoidable in the customary preparation and handling of the grade involved.

C5.2.2. Specifications for ferrous scrap are set forth by the Institute of Scrap Iron and Steel (ISIS). Specifications for grades that may be generated by DoD activities have been excerpted from the ISIS Handbook as revised in 1975, and listed in Attachment 1 to this chapter. Refer to the ISIS Handbook for the full listing of ferrous scrap specifications.

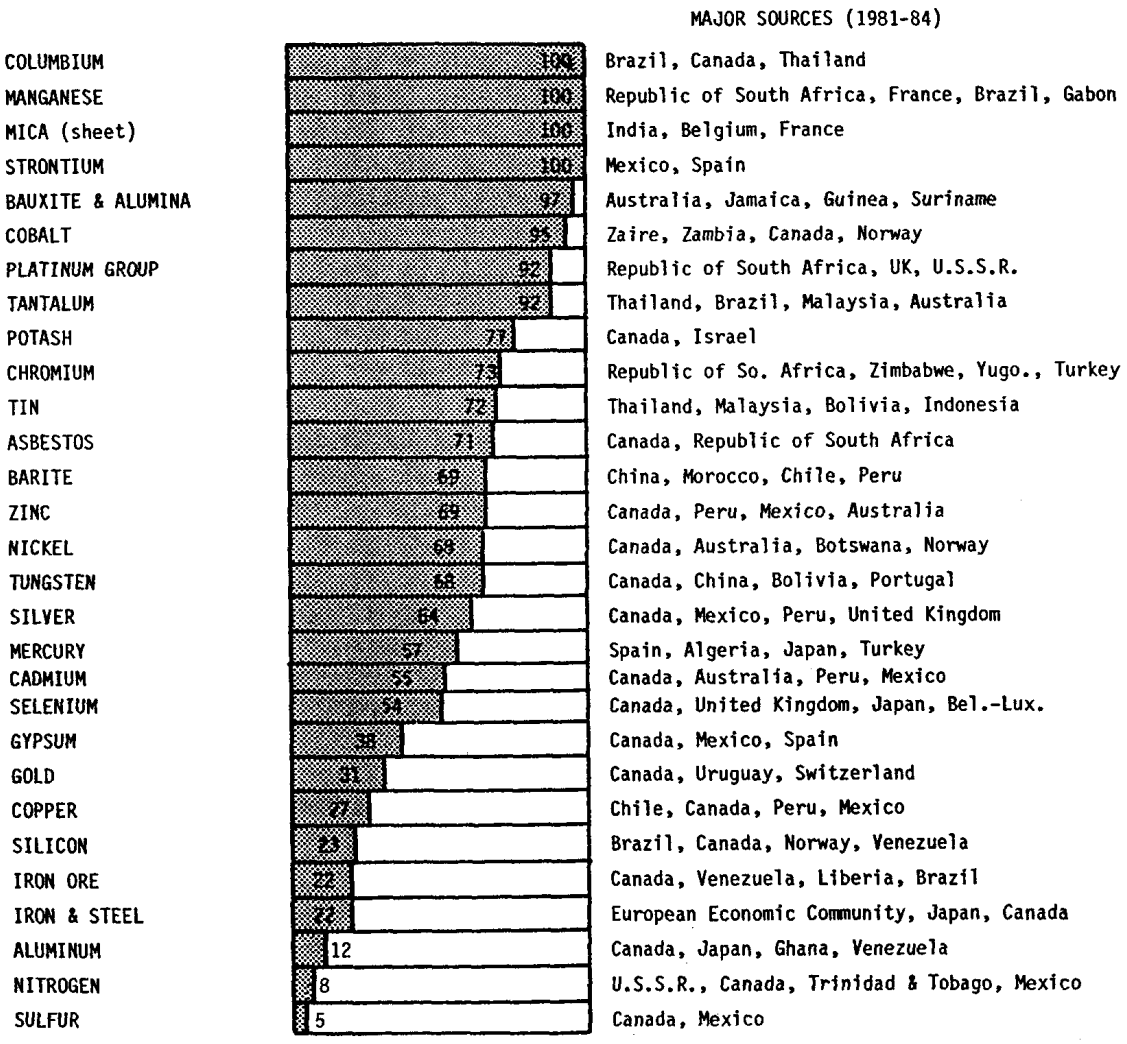
C5.2.3. Railroad ferrous scrap specifications, as set forth by the Association of American Railroads (AAR), are included in Attachment 1 to this chapter. These specifications, last revised in 1973 by the AAR Purchases and Materials Management Division, are excerpted from the ISIS Handbook.

C5.2.4. Special grades of steel scrap, which consist of alloys containing manganese, silicon, chromium, nickel vanadium, tungsten, molybdenum, or cobalt, are much more valuable than carbon steel scrap, and may be considered as contaminants when lotted with carbon steel scrap. Hence, when identifiable and present in sufficient quantity to justify separate handling, these special grades should be kept segregated from carbon steel. Special grades of steel include tool steels and such non-tool categories as springs, magnets, valves and bearings.

C5.3. NONFERROUS SCRAP

C5.3.1. Nonferrous scrap currently generates by far the largest proportion of gross proceeds received from the sale of scrap. Therefore, as indicated earlier in Chapter 1, DoD scrap yards should give priority attention to cost-effective management of nonferrous scrap operations.

Table C5.T1. 1985 Net Import Reliance e/ 1/
of Selected Non-fuel Mineral Materials
as a Percent of Apparent Consumption 2/
U.S.A.



e/ Estimated.

1/ Net import reliance = imports - exports + adjustments for Government and industry stock changes.

2/ Apparent consumption = U.S. primary + secondary production + net import reliance.
Source: Bureau of Mines (U.S. Department of the Interior)

C5.3.2. Industry specifications for nonferrous scrap are published by the National Association of Recycling Industries (NARI) in its Circular NF-82. (See Attachment 2, this chapter, for NARI specifications for those grades usually generated by DoD activities.) Stainless steel and high temperature alloy scrap are handled as nonferrous scrap, because of the value of their nonferrous constituents. (See Figures C5.F1. and C5.F2.)

C5.3.3. Stainless steels are produced for corrosion resistant applications through the addition of chrome and/or nickel to the ferrous base. The two major series of stainless steels are the 300 series (which is nonmagnetic and built around a basic content of 18 percent chromium and 8 percent nickel) and the 400 series (which is magnetic and normally devoid of nickel content). (See Table C5.T2. for specific alloy content of stainless steels.)

C5.3.4. High temperature alloys are produced to yield high strength in an operating environment where sustained high temperatures occur. Their alloy components are primarily combinations of nonferrous metals such as chromium, nickel, cobalt, molybdenum, tungsten, boron, columbium, titanium, aluminum, vanadium, and tantalum. The two major high value components of high temperature alloys are cobalt and nickel. (See Table C5.T3. for specific chemical compositions of high temperature alloys.) Because of the rapid pace of technological developments in the area of high temperature alloys, and the urgent need to prevent the loss of these scarce, high value critical and strategic materials, it is essential to give special attention to the identification and recovery of scrap containing these alloys. As previously indicated, proper identification of high temperature alloy scrap crucially depends on proper segregation at the source of generations. This is essential because the generators of high temperature alloys, who work with the applicable technical manuals and have immediate access to analytical laboratory facilities, are in the best position to identify the composition of these alloys. (See Figure C5.F3. for display board used for this purpose.)

Figure C5.F1. In This Sorting Area High Temperature and Stainless Steel Alloy Scrap Is Identified and Segregated.

Figure C5.F2. Nickel Base Titanium and Other High Temperature Alloy Scrap Can Receive Proceeds of Up to Several Dollars Per Pound When Properly Identified and Segregated.

Table C5.T2. Nominal Chemical Analysis of High Temperature Alloys

SCI Code	Stainless Steel Designation	Chromium	Nickel	Moly (Max.)	Managanese (Max.)	Carbon (Max.)	Silicon (Max.)	Other Elements
S01	301 LW	6.00	17.00					Cu 2.00
S01	301	6.00/8.00	16.00/18.00		2.00	0.15	1.00	
S01	302	8.00/10.00	17.00/19.00		2.00	0.15	1.00	
S01	303	8.00/10.00	17.00/19.00	0.60	2.00	0.15	1.00	Zr .60 max., 0.15 S
S01	303 Se	8.00/10.00	17.00/19.00		2.00	0.15	1.00	Se .15 min.
S01	304	8.00/12.00	18.00/20.00		2.00	0,08	1.00	
S01	304 L	8.00/12.00	18.00/20.00		2.00	0.03	1.00	
S01	305	10.00/13.00	17.00/19.00		2.00	0.12	1.00	
S01	309	12.00/15.00	22.00/24.00		2.00	0.20	1.00	
S01	310	19.00/22.00	24.00/26.00		2.00	0.25	1.50	
S01	312	8.00/11.00	27.00/30.00		2.00	0.25	1.00	
T14	314	19.00/22.00	23.00/26.00		2.00	0.25	1.50/3.00	
S01	316	10.00/14.00	16.00/18.00	2.00/3.00	2.00	0.08	1.00	
S01	317	11.00/15/00	18.00/20.00	3.00/4.00	2.00	0.08	1.00	
S01	321	9.00/12.00	17.00/19.00		2.00	0.08	1.00	Ti 5 xC min.
S01	322	6.25/7.75	16.25/17.25		.70	.05/.08	.70	
S01	322	6.25/7.75	16.25/17.25		.70	.05/.08	.70	Ti .70/1.0, Al .20/30
S01	323 (17-7 PH).	6.50/7.75	16.00/18.00		1.00	0.09	1.00	AL .75/1.50
S12	324 (17-4 PH).	3.00/5.00	15.50/17.50		1.00	0.07	1.00	Cu 3.00/5.00, Cb-Ta 0.25/0.45
T14	325	19.00/23.00	7.00/10.00		2.00	0.50	1.60	Cu 1.00/1.50
S12	327	3.00/5.00	25.00/30.00			0.25		
S12	329	2.50/5.00	23.00/28.00	1.00/1.50	2.00	0.20	1.00	
T33	330	33.00/36.00	14.00/16.00		2.00	0.25	1.00	
S01	347	9.00/13.00	17.00/19.00		2.00	0.08	1.00	Cb-Ta 10xC min.
S12	201	3.50/5.50	16.00/18.00	5.50/7.50	0.15	1.00	N 0.25 max.	

Table C5.T2. Nominal Chemical Analysis of High Temperature Alloys, continued

SCI Code	Stainless Steel Designation	Chromium	Nickel	Moly (Max.)	Managanese (Max.)	Carbon (Max.)	Silicon (Max.)	Other Elements
S12	202	4.00/6.00	17.00/19.00		7.50/10.00	0.15	1.00	N 0.25 max.
S12	211	5.25/5.00	10.00/16.25		6.00/6.25	0.07	.30/.60	Cu 1.50 to 2.00
S02	403		11.50/13.00		1.00	0.15	0.50	
S02	405		11.50/14.50		1.00	0.08	1.00	Al .10/.30
S02	410		11.50/13.50		1.00	0.15	1.00	
S02	414	1.25/2.50	11.50/13.50		1.00	0.15	1.00	
S02	416		12.00/14.00	.60	1.25	0.15	1.00	Ze 0.60 max.
S02	420		12.00/14.00		1.00	Over 0.15	1.00	
S02	430		14.00/18.00		1.00	0.12	1.00	
S02	431	1.25/250	15.00/17.00			0.20	1.00	
S02	432		16.00			0.10		Cu 1.00
S02	433	.50	16.00	1.00		0.10		Cu 1.00
S02	434		16.00	.75/1.25		0.10		Cu 1.00

Table C5.T3. Nominal Chemical Analysis of Stainless Steels

SCL Code	Designation	Nickel	Chromium	Cobalt	Moly	Tungsten	Copper	Carbon	Titanium	Aluminum	Other Elements
S21	14-14-2	14.00	14.00		3.50	2.40		.45			
S21	17-14 Cu-Mo	14.10	15.90		2.50		3.00	.12	.25		.45 CB
S17	19-9 DL	9.00	19.25		1.25	1.25		.30	.30		.40 CB
S17	19-9 WMo	9.00	19.00		.40	1.25		.10	.35		.40 CB
S17	19-9 DX	9.00	19.25		1.50	1.25		.30	.60		1.30 CB
S17	19-9 WX	8.50	20.50		.50	1.55		.11	.20		
T26	A.E.M. 47-50	47.50									52 Fe
T01	Alnico II	17.00		13.00			6.00	.10		10.00	54 Fe
T01	Alnico V	14.00		24.00			3.00			8.00	51 Fe
S12	AM-350	4.50	16.65		2.85			.09			
S12	AM-355	4.00	15.50		2.85			.13			
T05	A-286	25.50	15.00		1.30				2.10	.35	.30 V
T18	Astroloy	57.00	15.00	15.00	5.00				3.50	4.30	.20 Fe
S21	Carpenter 10	18.00	16.00					.08			
T06	Carpenter 20	27.00	20.00		2.50		3.5				45 Fe
T26	Carpenter 42	41.50							.10		.50 Mn, .25 Si, Bal Fe
T26	Carpenter 49	48.50									51 Fe
T26	Carpenter 52	51.00									.50 Mn, .25 Si, Bal Fe
T10	Constantin	43.00					55.00				1.34 Mn
T10	Copel	45.00					55.00				
T23	Discaloy	26.00	13.50		3.00				1.80	.35	
S3D	Duranickel	94.00						.15	.50	4.50	.15 Fe
T04	D-979	45.00	14.00		4.00				4.00	1.00	4.0 W
T09	Elgiloy	15.00	20.00	40.00	7.00			.15			17 Fe
T26	Elinvar Extra	42.00	5.00						2.50	.50	
T05	G-18-B	13.00	13.00	10.00	2.00	2.50		.40			3.00 CB+Ta
T07	Gannaloy	25.00	5.00					.03	2.25	.50	
S17	Gr. Ascoloy	2.00	13.00			3.00		.15			
T27	GMR-235	63.00	15.50		5.25			.10	2.00	3.00	
T15	HS-1 [1]		30.00	55.00		12.00		2.50			
T15	HS-3 [1]		31.00	50.00		12.50		2.40			3.00 Fe
T15	HS-4 [1]	3.00	30.00	50.00	1.50	14.00		1.00			3.00 Fe
T15	HS-6 [1]	3.00	29.00	60.00	1.50	4.50		1.10			3.00 Fe
T15	HS-12 [1]	3.00	30.00	56.00		8.50		1.40			3.00 Fe
T15	HS-19 [1]	3.00	31.00	52.00		10.50		1.70			3.00 Fe
T15	HS-21	2.50	27.00	60.00	5.50			.25			3.00 Fe
T03	HS-23	1.50	25.00	65.00		5.00		.40			2.00 Fe
T03	HS-25 (L-605)	10.00	20.00	52.00		15.00		.15			2.00 Fe
T25	HS-27	33.00	25.00	33.00	6.00			.40			2.00 Fe
T15	HS-30	15.00	26.00	50.00	6.00			.45			2.00 Fe
T15	HS-31	10.50	25.50	53.00		7.50		.50			2.00 Fe
T05	HS-56	13.00	21.00	12.00	4.50	1.50		.30			46.00 Fe
T01	HS-93	.50	17.00	6.00	16.00						53.00 Fe, 2V
T15	HS-98M-2	3.50	30.00	40.00	.80	18.50		2.00			2.50 Fe, 4V
T26	Hastelloy A	59.00			20.00			.10			
T26	Hastelloy B	64.00			28.00			.10			
T04	Hastelloy C	55.00	16.00		17.00	5.00		.15		1.00	
T01	Hastelloy D	85.00					4.00	.10			10.00 Si
T04	Hastelloy N	71.00	7.00		16.50			.06		.50	5.00 Fe
T32	Hastelloy R	65.00	15.50	1.50	5.00			.10	2.50	2.25	

Table C5.T3. Nominal Chemical Analysis of Stainless Steels, continued

SCL Code	Designation	Nickel	Chro-mium	Cobalt	Moly	Tung-sten	Copper	Carbon	Titani-um	Alumi-num	Other Elements
T32	Hastelloy R-235	67.00	15.50	2.50	5.00	.....	.....	.10	2.50	3.00	
T32	Hastelloy W	60.00	5.00	2.50	25.00	.....	.....	.12	.....	.....	.60 V
T32	Hastelloy	45.00	22.00	1.50	9.00	.60	.....	.10	.....	.....	
T26	Hipernik	50.00	.....	.....	.....	.....	.....	.....	.....	.....	50 Fe
S3D	Hy-Mu-80	80.00	.....	.....	4.00	.....	.....	.....	.....	.....	16 Fe
T04	Ilium G	57.00	22.50	.....	6.40	6.50	.....	.....	.....	.....	6.50 Fe
T27	Ilium R	64.00	22.00	.....	5.00	2.50	.....	.....	.....	.....	6.00 Fe
T30	In-100	60.00	10.00	15.00	3.00	.....	.....	.....	5.00	5.50	1.00 V
T08	Inconel (600)	76.00	15.80	.....	.....	.....	.10	.04	.....	.....	7.20 Fe
T08	Inconel W (722)	75.00	15.00	.....	.....	.....	.10	.55	2.40	.60	6.50 Fe
T08	Inconel X (X-750)	73.00	15.00	.....	.....	.....	.05	.04	2.50	.80	6.75 Fe, .85 CB
T08	Inco X-550 (751)	72.50	15.00	.....	.....	.....	.05	.04	2.50	1.20	6.75 Fe, 1.00 CB
T18	Inco 700	46.00	15.00	28.50	3.75	.....	.05	.12	2.20	3.00	.70 Fe
T08	Inco 713	74.00	11.50	.....	4.50	.....	.....	.12	.50	6.00	1.00 Fe, 2.00 CB
T04	Inco 718	52.50	18.00	.....	3.00	.....	.10	.04	.80	.60	18 Fe, 5.20 CB
T01	Inco 901	42.50	12.50	1.00	6.00	.....	.10	.05	2.70	.35	34 Fe
T06	Incoloy (800)	32.00	20.50	.....	.....	.....	.....	.....	.....	.....	46 Fe
T26	Invar	36.00	.....	.....	.....	.....	.....	.....	.....	.....	64 Fe
T20	Jetalloy 1570	29.00	20.00	37.50	.....	7.00	.....	.20	4.20	.....	
T18	K-42-B	43.00	18.00	22.00	.....	.....	.....	.....	2.50	.20	
T01	Kinsalloy	70.00	.....	.....	22.00	.....	.....	.....	.....	8.00	
T01	Kovar	29.00	.....	17.00	.....	.....	.....	.....	.....	.....	
T18	M-252	53.50	19.00	10.00	9.50	.....	.....	.15	2.50	1.00	
T23	M-308	32.50	13.75	.....	4.20	6.50	.....	.08	.....	.45	.15-2.35 Zr
T10	R Monel (#400)	66.00	.....	.....	.....	.....	31.50	.12	.....	.....	1.35 Fe
T10	Monel #401	44.50	.....	.....	.....	.....	53.00	.03	.....	.....	1.70 Fe, .50 Co
T10	Monel #410	66.00	.....	.....	.....	.....	30.50	.20	.....	.....	1.00 Fe, 1.60 Si
T10	K Monel (K-500)	65.00	.....	.....	.....	.....	29.50	.15	.50	2.80	1.00 Fe
T10	S Monel (#500)	64.00	.....	.....	.....	.....	29.00	.08	.....	.....	2.00 Fe, 4.00 Si
T10	H Monel (#506)	64.00	.....	.....	.....	.....	30.00	.10	.....	.....	1.50 Fe, 3.20 Si
T30	Mu Metal	77.00	1.50	.....	.....	.....	4.50	.....	.....	.....	
T20	N-155 (Mult)	20.00	20.00	20.00	3.00	2.50	.....	.12	.....	.....	30 Fe, 1.00 CB+Ta
S3D	Nickel 200 (A)	99.50	.....	.....	.....	.....	.05	.06	.....	.....	.15 Fe
S3D	Nickel 202	95.50	.....	.....	.....	3.80	.02	.03	.....	.....	.05 Fe
S3D	Nickel 204	95.20	.....	4.50	.....	.....	.02	.03	.....	.....	
S3D	Nickel 210	95.60	.....	.....	.....	.....	.50	.80	.....	.....	.50 Fe, 1.60 Si
S3D	Nickel 211 (D)	95.00	.....	.....	.....	.....	.03	.10	.....	.....	.05 Fe, 4.50 Mn
S3D	Nickel 213 (G)	95.00	.....	.....	.....	.....	.50	1.50	.....	.....	.50 Fe, 1.60 Si
S3D	Nickel 305 (S)	91.50	.....	.....	.....	.....	.50	.80	.....	.....	.50 Fe, 6.00 Si
S3D	Z Nickel	94.00	.....	.....	.....	.....	.05	.15	.50	4.50	.15 Fe
T30	Nicrotung	61.00	12.00	10.00	.....	10.00	.....	.10	4.00	4.00	
T33	Ni-o-nel (825)	41.80	21.50	.....	3.00	.....	1.80	.03	.90	.15	30.00 Fe
T04	Ni-o-nel (826)	51.50	30.00	.....	.....	.....	1.70	.04	.....	.....	
T26	Ni-Span-C	42.00	5.40	.....	.....	.....	.05	.02	2.40	.65	
T01	Nivco	22.50	.....	73.50	.....	.....	.....	.02	1.80	.22	
T16	Nimonic 75	77.60	20.50	.....	.....	.....	.05	.10	.35	.20	.50 Fe
T16	Nimonic 80A	74.50	20.50	.....	.....	.....	.05	.05	2.35	1.25	.55 Fe
T29	Nimonic 90	56.20	20.30	17.70	.....	.....	.05	.05	2.60	1.65	
T29	Nimonic 95	50.00	20.00	20.00	.....	.....	.....	.....	3.00	2.00	
T29	Nimonic 100	50.00	19.00	20.00	5.00	.....	.....	.10	3.00	2.00	
T18	Nimonic 105	46.00	15.00	20.00	5.00	.....	.....	.15	1.45	4.50	
T18	Nimonic 115	42.50	15.00	15.00	3.50	.....	.....	.20	4.00	5.00	
S3B	Niresist # 1	15.50	2.20	.....	.....	.....	6.00	3.00	.....	.....	2.00 Si

Table C5.T3. Nominal Chemical Analysis of Stainless Steels, continued

SCL Code	Designation	Nickel	Chromium	Cobalt	Moly	Tungsten	Copper	Carbon	Titanium	Aluminum	Other Elements
S3B	Niresist # 2	20.00	3.00					2.60			2.00 Si
S3B	Niresist # 3	30.00	3.00					2.60			1.50 Si
S3B	Niresist # 4	30.50	5.00					2.60			5.50 Si
T26	Niresist # 5	35.00	3.00					2.40			1.50 Si
S3D	Permanickel	98.60						.25	.50		.10 Fe, .35 Mg
T▮3	Permendur			50.00							50.00 Fe
T▮▮	PDRL	60.00	10.00	15.00	3.00				4.50	5.50	.75 V
S01	PH-15-7 Mo	7.00	15.00		2.50			.09		1.15	
T33	RA-330	35.00	19.00				.50	.06			
T32	RA-333	45.00	25.00	3.50	3.50	3.50	.50	.08			
T33	Refractoloy B	30.00	25.00		8.00			.07			
T2▮	Refractoloy 26	37.00	18.00	20.00	3.00				2.70	.50	
T2▮	Refractoloy 70	20.00	20.00	30.00	8.00	4.00		.05			
T2▮	Refractoloy 80	20.00	20.00	30.00	10.00	5.00		.10			
T▮1	Remalloy 17			12.00	17.00						.30 Mn, 71 Fe
T▮1	Remalloy 20			12.00	20.00						.30 Mn, 67.70 Fe
T18	Rene 41	52.00	19.00	11.00	10.00						
T▮1	Rodar	29.00		17.00							.30 Mn, Bal. Fe
T3▮	SM 200	60.00	9.00	10.00		12.50			2.00	5.00	
T▮3	SM 302	1.50	21.50	56.00		10.00		.85			9.00 Ta
T▮9	S-816	20.00	20.00	44.00	4.00	4.00		.35			5.00 Fe, 4.00 CB+Ta
T15	Star J	2.50	32.00	45.00		17.50		2.50			3.00 Fe
T28	Thetaloy (PWA 651).	46.00	25.00	12.50	3.00	7.00		.38			
T25	Ticonium	30.00	25.00	30.00	6.00			.06			
T▮6	Timken (16-25-6)	25.00	16.00		6.00						1.35 Mn
S21	Timken (16-15-6)	15.00	16.00		6.00						7.50 Mn
T▮6	Tinidur	30.00	15.00					.08	1.75	.40	
T26	Udimet A	25.00						.03	1.65	.30	Bal. Fe
T18	Udimet 500	53.00	17.50	16.50	4.00			.10	3.00	3.00	Bal. Fe
T18	Udimet 520	56.00	19.00	12.00	6.00	1.00			3.00	2.00	1.00 Fe
T18	Udimet 600	52.00	17.50	16.50	4.00				2.90	4.20	4.00 Fe
T18	Udimet 700	52.00	17.00	18.00	4.00				3.50	4.20	1.00 Fe
T26	Vicalloy	52.00									
T18	Waspaloy	56.00	19.00	14.00	4.00				3.00	1.20	2.00 Fe
T18	Waspaloy (Mod)	56.00	19.00	11.50	7.00				2.50	1.20	2.00 Fe

[1] Hayne's Stellite alloy.

C5.3.5. There are four levels of stainless steel and high temperature alloy identifications and segregations as follow:

C5.3.5.1. The highest level will generate the greatest proceeds from sale. This level requires segregation and identification to a specific alloy recognized by the American Society for Testing and Materials (ASTM), the American Society of Mechanical Engineers (ASME), the Aerospace Materials Specifications (AMS), or the Society of Automotive Engineers (SAE). (See Tables C5.T2. and C5.T3.)

C5.3.5.2. The second level is identification and segregation to a stainless steel or high temperature alloy group as listed respectively in Tables C5.T4.and C5.T5., and in Air Force T.O. 00-25-113. In most instances, this will generate significantly lower sale proceeds than the first level, because the buyer must pay for the costs of the additional sorting and processing required.

C5.3.5.3. The third level is identification and segregation to a general group of stainless steel and high temperature alloys (i.e., mixed stainless steels, such as 201, 304, 310, 316, 410, and 420-or mixed high temperature alloys including a nickel or cobalt base). This type of segregation involves a lesser amount of effort in identification, but sale proceeds are greatly reduced because alloys are then likely to require a great deal of additional identification and segregation by the buyer before they can be recycled effectively.

C5.3.5.4. The lowest, and unacceptable, level is to fail completely to identify high value alloys and allow them to become commingled with ferrous scrap. This will not only result in loss of scarce critical and strategic materials, but may also reduce the market value of the ferrous scrap-since many stainless steels and high temperature alloys (which are contaminants to ferrous scrap) are magnetic and thus can only be segregated by costly manual sorting.

Table C5.T4. Stainless Steel Alloy Groups (Magnetic and Nonmagnetic)

Group	Base Alloy	Material Alloy	Principal Elements (percent)
1	Stainless Steel	AISI Types 302, 303, 304, 305, 308, 316, 321, 347, 17-7PH and PH15-7MO, Inconel W and 321 when joined.	7-13 Ni, 17-19 Cr
2	Chrome, Stainless	AISI Types 403, 405, 410, 414, 416, 420, 430, 431, 440	0-2 Ni, 12-16 Cr
12	Chrome, Nickel, Iron	17-4PH, AM355.	4 Ni, 17 Cr
17	Chrome, Nickel, Iron	19-9DL, Greek Ascoloy.	2-9 Ni, 12-20 Cr
21	Stainless Steel	AMS 5700 Valves (PWA-143, WAC 8163).	14 Ni, 14 Cr
24	Chrome, Nickel, Iron	H. R. Crown (PWA 785, WAC 8338).	12 Ni, 25 Cr

Table C5.T5. HighTemperature Alloy Scrap Segregation Groups

Group	Base Alloy	Material Alloy	Principal Elements (percent)
3	Cobalt	Haynes Stellite (HS) 23, 25, 31, 36, L-605.	1-10 Ni, 12-16 Cr, 50-67 Co
4	Nickel	Hastelloy-C	55 Ni, 16 Cr
5	Chrome, Nickel, Cobalt	N-155 (Multimet), G18B, ()WA 658, 321 and N-155 when joined, 321 and HS-25 when joined, 321 and HS-21 when joined, 347 and HS-21 when joined, Timken 16-25-6 and HS-21 when joined, 347 and HS-21 when joined, Timken 16-25-6 and HS-21 when joined. Inconel 702 and HS-31 when joined.	2-20 Ni, 13-27 Cr, 10-60 Co
6	Nickel, Chrome, Iron	Timken 16-25-6.	25 Ni, 16 cr
7	Chrome, Nickel, Iron	Timken 16-25-6 and 4340 when joined. Timken 16-25-6 and 321 when joined.	1-25 Ni, 8-16 Cr
8	Nickel	Inconel, Inconel X, Inconel W, Inconel 702, Inconel 713.	70-74 Ni, 15 Cr
9	Cobalt	S-816(AMS 5765).	20 Ni, 20 Cr, 40 Co
10	Nickel	Monel.	60 Ni, 30 Cu
14	Stainless Steel	AISI 309, 309S, 310, 314, 446, Immaculate No. 5 (WAC 7824), Inconel and 310 when joined.	12-20 Ni, 24-25 Cr
15	Cobalt	HS-21, 30.	2-15 Ni, 26-27 Cr, 50-60 Co
16	Nickel	Nimonic 75, 80, 80AA, (wac 7830, 7831, 7832, 7834, 7835).	75-80 Ni, 20-21 Cr
18	Nickel	Waspalloy (PWA 675), (GE) M-252, Rene 41, Inconel 702 and Rene 41 when joined, Udimet 500.	55 Ni, 19 Cr, 13 Co
20	Nickel	Refractalloy 26, 80 (HS-33, Westinghouse 9269).	37 Ni, 18 Cr, 20 Co
22	Nickel	Inconel Valves	75 Ni, 20 Cr
23	Chrome, Nickel, Iron	A-286 Discaloy, Incoloy, Incoloy A (GE B50T9), Incoloy 901, (GE) M-308, Tinidur.	26-30 Ni, 13-20 Cr
25	Cobalt	HS-27.	30 Ni, 25 Cr, 30 Co
26	Nickel	Invar.	36 Ni
27	Nickel	GMR-235(Allison ES-73640).	60 Ni, 15 Cr
28	Nickel	Thetaloy PWA 651.	60 Ni, 25Cr, 12 Co

Table C5.T5. HighTemperature Alloy Scrap Segregation Groups, continued

Group	Base Alloy	Material Alloy	Principal Elements (percent)
29	Nickel	Nimonic 90 (WAC 7836).	58 Ni, 19 Cr. 18 Co
30	*Nickel*	*PWA663, B-1900.*	*64 Ni, 8 Cr., 10 Co*
32	Nickel	Hastelloy X.	45 Ni, 22 Cr, 1.5 Co
33	Nickel	AISO 330.	45 Ni, 15 Cr
55	Tungsten	Tungsten.	90W
60		Titanium	80 Ti
62	*Beryllium*	Beryllium	*Beryllium (BE)*
65	Alloy, high temperature	Coated, plated or brazed with silver.	
70	Alloy, high temperature	Coated, plated or brazed with gold.	
75	Alloy, high temperature	Coated, plated or brazed with platinum.	

C5.4. PAPER, CARDBOARD, AND CORRUGATED SCRAP

C5.4.1. Industry specifications for these types of scrap are published by the Paper Stock Institute of America, a commodity division of the National Association of Recycling Industries (NARI), in its Circular PS-83. Excerpts of specifications for those grades usually generated by DoD activities are included in Attachment 3 to this chapter. The terminology used in these descriptions is as follows:

C5.4.1.1. "Outthrows" are defined as "all papers that are so manufactured or treated or are in such form as to be unsuitable for consumption as the grade specified."

C5.4.1.2. "Prohibitive Materials" are defined as:

C5.4.1.2.1. Any materials which by their presence in a packing of paper stock, in excess of the amount allowed, will make the packing unusable as the grade specified.

C5.4.1.2.2. Any materials that may be damaging to equipment.

C5.4.1.2.3. The maximum quantity of "Outthrows" indicated in connection with the grade definitions in Attachment 3 is understood to be the total of "Outthrows" and "Prohibitive Materials."

C5.4.2. The "Prohibitive Materials" and "Outthrows" listed for selected grades in Table C5.T6. are intended to be specific but should not be considered an all-inclusive list.

Figure C5.F3. Display Board Used to Assist in the Identification and Segregation of High Temperature Alloys

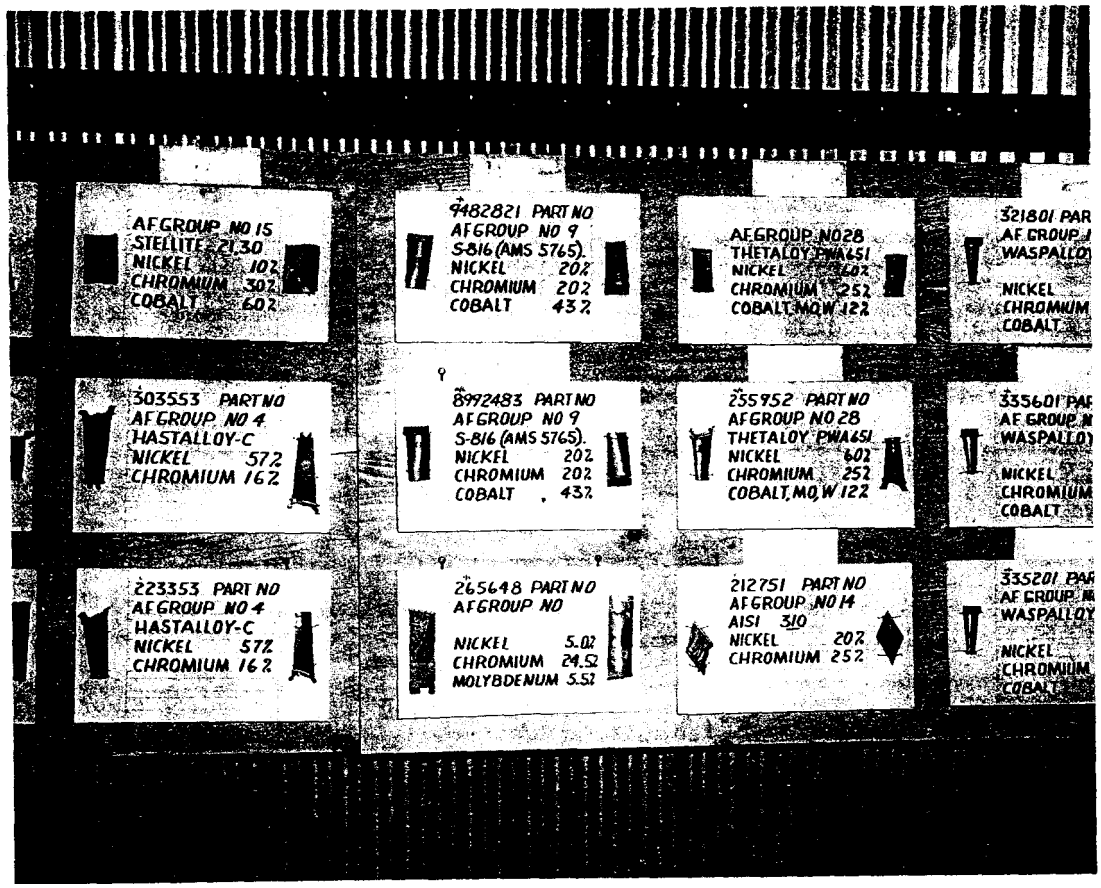


Table C5.T6. Prohibitive Materials and Out-Throws

Sorted COLORED Ledger and Manifold COLORED Ledgerx

PROHIBITIVE MATERIALS			OUTTHROWS
Pressure Sensitive Adhesives	Plastic Coatings	Parchment	Unbleachable Beater-Dyed Papers
Heat Seal Adhesives	Wet Strength Coatings	Cellophane	
Latex Adhesives	Foil Coatings	Telefax Type Papers	Cloth Bindings
Acetate Adhesives	Wax Coatings	Carbon Paper	String Bindings
Moisture Barrier Laminations	Adhesive Bindings	Asphalt Papers	Thread Bindings
Wet Strength Papers	Plastic Bindings	Film	Punchings
Treated Copy Papers	Heavy Metal Bindings	Tip Ons	Glassine
Magnetic Inks	Blueprint	Hard Covers	Plastisol Inks
Metallic Inks	Photographic Papers	Coarse Groundwood	Fluorescent Inks
Heavy Overprint	Billboard Posters	Krome Kote	High Gloss Inks
Ink Wads	Picture Post Card Stock	Varnish & Lacquer Coatings	
Latex Coatings	Labels	Chipboard	

Sorted WHITE Ledger and Manifold WHITE Ledger

PROHIBITIVE MATERIALS		OUTTHROWS	
Pressure Sensitive Adhesives	Plastic Coatings	Cellophane	Cloth Bindings
Heat Seal Adhesives	Wet Strength Coatings	Telefax Type Papers	String Bindings
Latex Adhesives	Foil Coatings	Carbon Paper	Thread Bindings
Acetate Adhesives	Wax Coatings	Asphalt Papers	Punchings
Moisture Barrier Laminations	Adhesive Bindings	Film	Glassine
Wet Strength Papers	Plastic Bindings	Tip Ons	Plastisol Inks
Treated Copy Papers	Heavy Metal Bindings	Hard Covers	High Gloss Inks
Fluorescent Inks	Blueprint	Coarse Groundwood	
Magnetic Inks	Photographic Papers	Krome Kote	
Metallic Inks	Billboard Posters	Varnish & Lacquer Coatings	
Heavy Overprint	Picture Post Card Stock		
Ink Wads	Labels	Chipboard	
Latex Coatings	Parchment		

Table C5.T6.Prohibitive Materials and Out-Throws, continued

Coated Book Stock

PROHIBITIVE MATERIALS		OUTTHROWS	
Pressure Sensitive Adhesives	Latex Coatings	Picture Post Card Stock	Deep Colored Beater-Dyed Papers
Heat Seal Adhesives	Plastic Coatings		
Latex Adhesives	Wet Strength Coatings	Parchment	Krome Kote
Acetate Adhesives	Foil Coatings	Cellophane	Varnish & Lacquer Coatings
Moisture Barrier Laminations	Wax Coatings	Telefax Type Papers	Chipboard
Wet Strength Papers	Adhesive Bindings	Carbon Paper	Cloth Bindings
Treated Copy Papers	Plastic Bindings	Asphalt Papers	String Bindings
Magnetic Inks	Heavy Metal Bindings	Film	Thread Bindings
Metallic Inks	Blueprint	Tip Ons	Glassine
Heavy Overprint	Photographic Papers	Hard Covers	Plastisol Inks
Ink Wads	Billboard Posters	Coarse Groundwood	Fluorescent Inks
			High Gloss Inks

C5.5. PLASTIC SCRAP

C5.5.1. There is a rapidly increasing worldwide emphasis on the innovative use of plastics as substitutes for more conventional raw materials used in the manufacture of such major commodities as automobiles, electrical appliances, clothing, packaging, building materials, and household items. It is therefore necessary to give increased attention to the recovery and recycling of plastic scrap generated by DoD activities.

C5.5.2. There are over fifty distinctly different types of plastics that fall within seventeen general classes. (See Tables C5.7. through C5.T9.) Each type has a range of properties depending upon its composition and the basic resin used. The major classes are:

C5.5.2.1. Acrylics: polymethacrylates, polyacrylates, and acrylonitrile copolymers.

C5.5.2.2. Alkyd resins.

C5.5.2.3. Cellulosics: cellulose acetate, cellulose propionate, cellulose acetate-butyrate, ethyl cellulose, methyl cellulose, nitrocellulose, sodium carboxymethyl-cellulose.

C5.5.2.5. Epoxy resins.

C5.5.2.6. Melamine resins: melamine formaldehyde.

C5.5.2.7. Nylons: polyamide.

C5.5.2.8. Phenolic resins: phenol-formaldehyde resins, phenol-furfural resins.

C5.5.2.9. Polyester resins.

C5.5.2.10. Polyfluorocarbons: polytetrafluoroethylene, polymers of chlorotrifluoroethylene (fluorthene), vinylidene fluoride, hexafluoropropylene.

C5.5.2.11. Polyformaldehyde resins.

C5.5.2.12. Polyolefines: polythylenes, polypropylene, poIybutenes, polypentenes.

C5.5.2.13. Polystyrenes.

C5.5.2.14. Polyurethane resins (isocyanate resins).

C5.5.2.15. Silicone resins.

C5.5.2.16. Ureas (carbamide): urea-formaldehyde resins.

C5.5.2.17. Vinyls: polyvinylacetate (PVA), polyvinylchloride (PVC), polyvinylchlorideacetate, polyvinyl alcohol, polyvinylacetals.

C5.5.2.18. Polycarbonates and polychloroethers.

C5.5.3. Most plastics fall under two groups-thermoplastic or thermosetting, as defined below-depending upon the changes that take place in their physical characteristics when heated. However, polyurethanes are included in both groups.

C5.5.3.1. The word "thermoplastic" is an adjective applied to plastics such as polystyrenes, acrylics and vinyls, which can be softened by heating. Upon cooling they regain their solid state, thus permitting reprocessing of scrap materials. Appproximately 80 percent of all plastics are in this category.

C5.5.3.2. The word "thermosetting" is an adjective applied to plastics (such as melamine, phenolics, polyester, ureas, and epoxies), which solidify upon heating and cannot be remelted. Even though thermosetting materials cannot be reprocessed as plastics, there is a market for such scrap for regrinding and use as filler, and as an ingredient in fertilizer.

C5.5.4. For safety and health reasons, DoD scrap yard personnel are not permitted to heat or flame test plastic materials for identification purposes. They must therefore work closely with generators of plastic scrap to ensure that they segregate it at its source and identify it by its common or trade name. In most cases, scrap yard personnel must then convert this name into its chemical name in order to determine whether a market exists and, if so, the current market value. Tables C5.T7. 5-8,and C5.T9. provide cross-references between the chemical name and the common or trade names of selected plastics, together with helpful information as to their composition, characteristics, and typical applications.

C5.5.5. Scrap yard supervisors should confirm the marketability of plastic scrap before devoting significant effort to segregation and lotting. However, all generations of plastic scrap should be kept clean and free from contamination; and it should be stored under shelter, if feasible.

Table C5.T7. General Categories of Plastics

Chemical Name	Composition	General Characteristics	Typical Applications	Some Common and Trade Names
Cellulose acetate	A transparent material, amber in color, made by the reaction of cellulose with acetic acid or acetic anhydride in the presence of sulfuric acid.	Thermoplastic; nonflammable; good light and heat stability; tough; easily molded; easily machined; unlimited color possililities.	Safety photographic film; motion picture film; packaging; textile fibers; fluorescent light fixtures; toys and novelties.	Nixon C/A Tenite C/A Celanese Fibestos Vuepak Vuelite Kodapk Cleasite Joda C/A Sicalit Sicaloid Sicafoil Cellon TEC Wopalon Lumarith Estron Cellomold Celastoid Protectoid
		Coatings and lacquers are adhesive, tough, resilient, and do not discolor easily.	Solvents; glazing; injection molding; specially processed fiber for parachutes and fine fabrics.	Vimlite Miramesh Masuron Nixonite Plastacele Acele Lanese Fortisan Forticel Arnel

Table C5.T7. General Categories of Plastics, continued

Chemical Name	Composition	General Characteristics	Typical Applications	Some Common and Trade Names
		Toughest of the thermo-plastics; low nitrates flammable; high nitrates highly explosive; requires special molding; burns with a smokey flame and the fumes are poisonous.	Fountain pen bodies; ping-pong balls; rayons; smokeless powder.	Amarith Celluoid Nitron Nixonoid Pyroxylin
				Pyralin
				Fiberloid
				Viscaloid
			Lacquers	Duco
				Zapon
				Arcoson
Mele mine-formaldehyde	An alkyd type synthetic resin made by reacting melamine with formaldehyde.	Superior quality thermoset; has good heat and color stability.	Dinnerware; buttons; arc-resistant electrical parts; impregnating paper or fabrics; shrink proofing woolen fabrics; adhesives; coatings; and varnishes.	Melmac Plaskon Resimene Melamine
				Lanoset
				Herculoid
				Hycoloid
				Pyra-Shell
				Nitron
Phenol-formaldehyde	Synthetic Resin of phenol and formaldehyde; used primarily as a molding material for making mechanical and electrical parts.	Thermosetting; glossy finish; good electrical properties and chemical resistance.	Appliance handles; electrical switches; wiring devices gears, housings, panels, etc.	Bakellite Redmanol Resinox

Table C5.T7. General Categories of Plastics, continued

Chemical Name	Composition	General Characteristics	Typical Applications	Some Common and Trade Names
				Durez
				Durite
				Catalin
				Moldarts
				Synvar
				Crystallin
				Phenalin
				Ivoricast
				Prystal
				Marblette
Polyamide (nylon)	Made by polymerization of a dibasic acid and a diamine. Most common one is produced by reaction of adipic acid and a hexamethylene diamine.	Thermoplastic; high tensile strength; tough.	Textiles; gears; bushings; wire jacketing.	Nylon Zytel Nyloft
Polychlorotrifluoroethylene	Polymers of chlorotrifluoroethylene.	Moldable; chemically inert; temperature resistant; strong.	Valve seats; terminal blocks; transparent cover plates; insulating film.	
Polyester resin	Large group of synthetic resins made by condensation of acids such as itaconic, malsic, or phthalic with an alcohol or glycol.	High strength; good chemical resistance; high adhesion; capable of taking birght colors.	Laminating and impregnating materials; insulation for electronc components; electrical appliances; close-tolerance moldings; translucent panels; boats; tanks; trays; structural sheeting.	Dapon Selectron Vibrin Hectron Marco

Table C5.T7. General Categories of Plastics, continued

Chemical Name	Composition	General Characteristics	Typical Applications	Some Common and Trade Names
				Aropol
				Paraplex
				Laminac
Polyethylene	Polymerized ethylene	Thermoplastic; tasteless, oderless, and nontoxic; light weight; tough; flexible; even at low temperatures; chemically inert; outstanding electrically; easily processed and colored.	Film and sheets for packaging; all types of molded containers; coaxial cable dielectric; electrical parts and fixtures; tank and pipe linings; upholstry; coatings; window glazings.	Polythylene Petrothene Alathone Alkathene Agilene
				Dylan
				Orizon
Polymethyl methacrylate	Polymers or copolymers of acrylic acid, esters of these acids, or acrylonitrile.	Thermoplastic; optical clarity; easily formed; stable to outdoor weathering; dimensionally stable.	Aircraft canopies and windows; illuminated signs; contact lens and optical parts; dentures; surgical instruments; safety glass; binder in rock propellants; lacquers; paints, and finishes.	Lucite Plexiglass Perspex Plexene Vernonite
				Crystalite
				Lucitone
				Rhoplex
				Crilicon
				Acryloid
Polystyrene	A synthetic resin formed by the polymerization of styrene (vinyl Benzene).	Thermoplastic; very tough; extra high insulating power; optical clarity; easy molding; relatively inexpensive; deteriorates if outdoors.	Refrigerators and air conditioners; fan blades; wall tile' battery cases; ladder line insulators; impregnation of electric coils; bonding of abrasives; lamination of fabrics; toys and novelties.	Polystyrene Styrene Styron Luxtrex Styrex

Table C5.T7. General Categories of Plastics, continued

Chemical Name	Composition	General Characteristics	Typical Applications	Some Common and Trade Names
				Ampacet
				Plioite
				Victron
				Lustron
				Cellulite
Polytetrafluoroethylene	A polymer, plastic or resin derived from tetrafluoroethylene. It is abbreviated PTFE and is sometimes called TFE fluorcarbon resin. Has the same general structure but the hydrogen is replaced by fluorine.	Opaque; mil-white; waxy texture; water resistant; highly chemical resistant; self lubricating.	Bearings; gaskets; linings for tanks; non-sticking coatings; high-frequency insulation.	PTFE Teflon
Polyvinyl butyral	One of the resins which come under the general heading of Polyvinyl Acetal Resins which are formed by the condensation of acetaldehyde or any other aldehyde with polyvinyl alcohol.	Extremely tough; optically stable; flexible over wide temperature range.	Safety glass; bullet-proof glass; shatterproof laminates; strippable coatings; waterproofing fabrics.	Butacite Butvar Saflex
Polyvinyl chloride	Abbreviated PVC; a common and widely used synthetic resin, derived from reacting ethylene with hydrogen chloride. Also called ethylene chloride and chloroethylene.	Thermoplastic; properties vary widely with method of polymerization.		
		Unplasticized: strong and rigid; resistant to chemicals	Piping for chemical process industries; acid tanks; ducts; flumes; highway signs; floor coverings.	Vinyl PVC Exon
				Vyflex

Table C5.T7. General Categories of Plastics, continued

Chemical Name	Composition	General Characteristics	Typical Applications	Some Common and Trade Names
		Copolymer: fabricated to close tolerances; stable dimensionally.	Phonograph records, advertising displays; coatings.	Geon Opalon
				Pliovic
				Ultron
		Flexible: (plasticized) heat sealable; controlled flexibility; flame restant.	Insulation for electrical wiring; shower curtains; garden hose; upholstery; luggage.	Aglide Marvinol Tygon
				Welvic
Polyvinylidene chloride	Athermoplastic derived from the polymerization of ethylene and chlorine.	Strong, hard; water and grease-resistant; odorless; tasteless.	Film for packaging; monofiliments; coating paper; impregnating clothing.	Saran Velon
Silicones	Resin-like materials in which silicon takes place of carbon in the organic synthetic resins. Designated inorganic plastics.	Temperature resistant; highly water resistant; high dielectric strength.	High-temperature electric and electronic components; water-proofing; strong cements for bonding various materials.	Silicone Velvasil Thermocone
				Dry-Film 9977
				Resin XR-807
Urea-formaldehyde	Aresin made by condensing urea or thiourea with formaldhyde.	Thermosetting; rigid; light-colored.	Closures; buttons; wiring devices; wallboard; laminates adhesive sizing.	Plaskon Sylplast Beetle
				Uformite
				Weldwood
				Casco
				Cascamite
				Polybond
				Arodure
				Symvarite

Table C5.T8. Thermoplastics (Remeltable)

Term	Features	Some Trade Names
ABS*	Excellent toughness	Kralastic-Naugatuck Chemical Division
Acetal	Extremely rigid	Delrin-DuPont
Acetates	Tough, hard, easily colored	Lumarity-Celanese Plastacele-DuPont Vuepak-Monsanto
Butyrates	Tough, good weatherability	Tenite Butyrate-Eastman
Cellulose propionate	No odor, stable, bright finish	Forticel-Celanese
Cellolose nitrate	Tough, hard surface, inflammable	Nixon C/N-Nixon Nitration Herculoid-Hercules Powder
Ethyl cellulose	Tough, stands hard treatment	Hercocel E-Hercules Powder Nixon E/C-Nixon Nitration
Flurocarbon	Highly chemical resistant	Teflon-DuPont Zytel-DuPont
Polyamides (nylon)	Strong and extra tough; stands high temperature	Plaskon-Allied
Polycarbonate	High impact strength	Lexan-General Electric
Polyether (chlorinated)	Excellent chemical resistance	Penton-Hercules
Polyethylene	Light weight and squeezable	Poly-eth-Spencer Alathon-DuPont
Polypropylene	Light weight, unusual chemical resistance	Escon-Humble Oil
Polystyrene	Brilliant, rigid, colorful	Styron-Dow Lustrex-Monsanto
Vinyls	Versatile, multipurpose, colorful	Exon-Firestone Marvinol-Naugatuck

* Acrylonitrile-Butadiene-Styrene

Table C5.T9. Thermosetting Materials (Non-Remeltable)

Term	Features	Some Trade Names
Alkyds	Good electrical properties	Plaskon-Allied
Allyls	Low electrical loss	Dapon-FMC Corp.
Caseins	Good color range	Cascoloid-Borden
Epoxies	Excellent adhesion	Epon-Shell Chemical
Melamines	Strong and light-fast	Melmac-Americal Cyanamid
Phenolics	Hard, rigid, strong	Resinox-Monsanto
Polyesters	Tough-hard surface	Mylar-DuPont
Silicones	Resistant to 590 0 F	Silastic-Dow Corning
Ureas	Colorful, dimensionally stable	Lauxite-Monsanto
Urethanes	Tough, tear resistant	Mondur-Mobay Chemical

C5.6. USED PETROLEUM PRODUCTS

Because ofthe extent of United States dependence on foreign production of petroleum products, we should place the same emphasis on cost-effective recovery and recycling of used petroleum products as we place on recovery and recycling of other critical and strategic materials generated in the DoD scrap stream. It is therefore essential to ensure careful source segregation of used petroleum products, avoidance of intermingling of these products, and handling them in such a manner as to preclude or at least minimize contamination. If this is accomplished, and if we provide buyers from the recycling industry with accurate and precise descriptions in our sales offerings (including data on any contaminants, and chemical analyses when appropriate), we can improve net DoD benefits through increased proceeds from sale. Such offerings must clearly identify both Federal and state requirements when such products are declared as hazardous wastes.

C5.7. USED SYNTHETIC LUBRICANTS

Requirements for cost-effective recovery and recycling of synthetic lubricants are generally comparable to those outlined above for used petroleum products. However, because of the substantially greater unit value of used synthetic lubricants, they warrant a comparable increase in the amount of scrap yard effort devoted to handling them.

C5.8. INDUSTRIAL DIAMONDS/RESIDUE

Industrial diamonds are used in dressing abrasive wheels, and as a component of grinding wheels, turning, and boring tools, diamond dies, and drill bits. Although some DoD activities are now using synthetic diamonds, which produce no valuable residue, many military arsenals, weapons plants, and other industrial activities still use industrial diamond tools, which generate diamond swarf, sluqdge, and chips from broken drill bits. This residue is quite valuable and should be recovered wherever generations are sufficient to warrant the cost of recycling it.

C5.8.1. Swarf is a relatively dry dust derived from (a) grinding operations where no coolant or lubricant is applied to the grinding operation, or (b) where the coolant (kerosene, as aqueous solution, or an emulsion of oil and water) is sprayed on the wheel in the form of a fine mist. In either case the resultant swarf can be discharged through a pipeline and deposited into a suitable dust collector.

C5.8.2. Sludge is a wet, oily product, obtained where liberal quantities of coolant are applied to the work, resulting in a semifluid mixture which can be discharged into a collecting chamber below the grinding machine. The excessive liquid may be separated from the solids by decantation or filtration.

C5.8.2.1. Dry dust (swarf normally yields more diamonds per pound of scrap than does sludge from wet-grinding. However, all substantial quantities of both should be recovered. There are a number of recovery units on the market for collections from both dry and wet-grinding operations.

C5.8.2.2. In studying the possibilities of a diamond recovery program, the number of wheels consumed per month, wheel size, concentration, etc., must be considered. In instances where only one grinding machine is used only five or six times a year there could not be enough diamond collected to cover the cost of collection. The collection of diamonds from machines where only metal-bonded diamond wheels are used usually proves uneconomical, as the metal bond holds the diamond grit tighter and the grit is fractured into sizes that may not be economical to salvage.

C5.9. WOOD SCRAP

Short lengths of lumber and plywood, wood chips, shavings, sawdust, and other wood scrap have recycling value for hobbyists, home tinkerers, and repairmen, or used as heating fuel or other uses. While the value of wood scrap per unit of weight may be low, there is a significant cost avoidance in its sale in lieu of abandonment or destruction. Caution should be exercised in identifying and handling wood scrap that may have been treated with chemical compounds, such as pentachlorophenol (PCP).

C5.10. RECYCLABLE AGRICULTURAL PRODUCTS

Many military installations have underutilized acreages of hays and other grasses. In areas where a sufficient agricultural demand exists, the Defense Property Disposal Service can provide a valuable sales service for the harvest and utilization of these products.

C5.11. ACCOUNTING FOR SCRAP

To supplement the standard scrap specifications d by the scrap recycling industry in the United States, the Defense Property Disposal Service has developed its own Scrap

Classification List (SCL) Codes for scrap primarily for inventory and accounting purposes (see Attachment 4). When DoD scrap is generated in a form that is not economically convertible to an industry scrap specification, these SCL codes may be used in segregating and lotting such scrap. For example, aluminum shell casings generated on an artillery range should be kept segregated from brass shell casings, and accounted for and described for sale respectively under SCL codes D1I and D2E.

Attachments - 4

C5.A1. Industry Specifications for Ferrous Scrap
C5.A2. Industry Specifications for Nonferrous Scrap
C5.A3. Paper Scrap
C5.A4. Defense Reutilization & Marketing Service Scrap Classification List

C5.A1. ATTACHMENT 1 TO CHAPTER 5

INDUSTRY SPECIFICATIONS FOR FERROUS SCRAP[1]

Basic Open Hearth, Basic Oxygen, Electric Furnace, and Blast Furnace Grades

		ISIS Code Number
(1)	No. 1 heavy melting steel. Wrought iron and/or steel scrap 1/4 inch and over in thickness. Individual pieces not over 60 x24 inches (charging box size) prepared in a manner to insure compact charging.	200
(2)	No. 1 heavy melting steel 3 feet x18 inches. Wrought iron and/or steel scrap 1/4 inch and over in thickness. Individual pieces not over 36 inches x18 inches (charging box size) prepared in a manner to insure compact charging.	201
(3)	No. 1 heavy melting steel 5 feet x18 inches. Wrought iron and/or steel scrap 1/4 inch and over in thickness. Individual pieces not over 60 inches x18 inches (charging box size) prepared in a manner to insure compact charging.	202
(4)	No. 2 heavy melting steel. Wrought iron and steel scrap, black and galvanized, 1/8 inch and over in thickness, charging box size to include material not suitable as No. 1 heavy melting steel. Prepared in a manner to insure compact charging.	203
(5)	No. 2 heavy melting steel. Wrought iron and steel scrap, black and galvanized, maximum size 36 x18 inches. May include all automobile scrap properly prepared.	204
(6)	No. 2 heavy melting steel 3 feet x18 inches. Wrought iron and steel scrap, black and galvanized, maximum size 36 x18 inches. May include automobile scrap, properly prepared, however, to be free of sheet iron or thin gauged material.	205
(7)	No. 2 heavy melting steel 5 feet x18 inches. Wrought iron and steel scrap, black and galvanized, maximum size 60 x18 inches. May include automobile scrap, properly prepared, however, to be free of sheet iron or thin gauged material.	206
(8)	No. 1 busheling. Clean steel scrap, not exceeding 12 inches in any dimensions, including new factory busheling (for example, sheet clippings, stampings). May not include old auto body and fender stock. Free of metal coated, limed, vitreous enameled, and electrical sheet containing over 0.5 percent silicon.	207
(9)	New Black Sheet Clippings. For direct charging, maximum size 8 feet x18 inches, free of old automobile body and fender stock, metal coated, limed, vitreous enameled and electrical sheet containing over 0.5 percent silicon, must lay reasonably flat in car.	207A
(10)	No. 1 bundles. New black steel sheet scrap, clippings or skeleton scrap, compressed or hand bundled, to charging box size, and weighing not less than 75 pounds per cubic foot. Hand bundles are tightly secured for handling with a magnet.) May include Stanley balls or mandrel wound bundles or skeleton reels, tightly secured. May include chemically detinned material. May not include old auto body or fender stock. Free of metal coated, limed, vitreous enameled, and electrical sheet containing over 0.5. percent silicon.	208
(11)	No. 2 bundles. Old black and galvanized steel sheet scrap, hydraulically compressed to charging box size and weighing not less than 75 pounds per cubic foot. May not include tin or lead-coated material or vitreous enameled material.	209

Basic Open Hearth, Basic Oxygen, Electric Furnace, and Blast Furnace Grades

		ISIS Code Number
(12)	No. 3 bundles. Old sheet steel, compressed to charging box size and weighing not less than 75 pounds per cubic foot. May include all coated ferrous scrap not suitable for inclusion in No. 2 bundles.	214
(13)	Incinerator bundles. Tin can scrap, compressed to charging box size and weighing not less than 75 pounds per cubic foot. Processed through a recognized garbage incinerator.	215
(14)	Terne plate bundles. New terne plate sheet scrap, clippings or skeleton scrap, compressed or hand bundled, to charging box size, and weighing not less than 75 pounds per cubic foot. (Hand bundles are tightly secured for handling with a magnet.) May include Stanley balls or mandrel wound bundles or skeleton reels, tightly secured.	216
(15)	Bundled No. 1 steel. Wrought iron and/or steel scrap 1/8 inch or over in thickness, compressed to charging box size and weighing not less than 75 pounds per cubic foot. Free of all metal coated material.	217
(16)	Bundled No. 2 steel. Wrought iron or steel scrap, black or galvanized, 1/8 inch and over in thickness, compressed to charging box size and weighing not less than 75 pounds per cubic foot. Auto body and fender stock, burnt or hand stripped, may constitute a maximum of 60 percent by weight. (This percentage based on makeup of auto body, chassis, driveshafts, and bumpers.) Free of all coated material, except as found on automobiles.	218
(17)	Machine shop turnings. Clean steel or wrought iron turnings, free of iron borings, nonferrous metals in a free state, scale, or excessive oil. May not include badly rusted or corroded stock.	219
(18)	Machine shop turnings and iron borings. Same as machine shop turnings but including iron borings.	220
(19)	Shoveling turnings. Clean short steel or wrought iron turnings, drillings, or screw cuttings. May include any such material whether resulting from crushing, raking, or other processes. Free of springy, bushy, tangled or matted material, lumps, iron borings, nonferrous metals in a free state, scale, grindings, or excessive oil.	221
(20)	Shoveling turnings and iron borings. Same as shoveling turnings, but including iron borings.	222
(21)	Iron borings. Clean cast iron or malleable iron borings and drillings, free of steel turnings, scale, lumps, and excessive oil.	223

Electric Furnace Casting, and Foundry Grades

(1)	Bar crops and plate scrap. Bar crops, plate scrap, forgings, bits, jars, and tool joints, containing not over 0.05 percent phosphorus or sulphur, not over 0.5 percent silicon, free from alloys. Dimensions not less than 1/2 inch in thickness, not over 18 inches in width, and not over 36 inches in length.	230

Electric Furnace Casting and Foundery Grades, continued

		ISIS Code Number
(2)	Plate and structural steel, 5 feet and under. Cut structural and plate scrap, 5 feet and under. Clean open hearth steel plates, structural shapes, crop ends, shearings, or broken steel tires. Dimensions not less than 1/4 inch thickness, not over 5 feet in length and 18 inches in width. Phosphorus or sulphur not over 0.05 percent.	231
(3)	Plate and structural steel, 5 feet and under.Cut structural and plate scrap, 5 feet and under. Clean open hearth steel plates, structural shapes, crop ends, shearings, or broken steel tires. Dimensions not less than 1/4 inch thickness, not over 5 feet in length and 24 inches in width. Phosphorus or sulphur not over 0.05 percent.	232
(4)	Cast steel. Steel castings not over 48 inches long or 18 inches wide, and 1/4 inch and over in thickness, containing not over 0.05 percent phosphorus or sulphur, free from alloys and attachments. May include heads, gates, and risers.	233
(5)	Punchings and plate scrap. Punchings or stampings, plate scrap, and bar crops containing not over 0.05 percent phosphorus or sulphur and not over 0.5 percent silicon, free from alloys. All material cut 12 inches and under, and with the exception of punchings or stampings, at least 1/8 inch in thickness. Punchings or stampings under 6 inches in diameter may be any gauge.	234
(6)	Electric furnace-bundles. New black steel sheet scrap hydraulically compressed into bundles of size and weight as specified by consumer.	235
(7)	Cut structural and plate scrap, 3 feet and under. Clean open hearth steel plates, structural shapes, crop ends, shearings, or broken steel tires. Dimensions not less than 1/4 inch in thickness, not over 3 feet in length and 18 inches in width. Phosphorus or sulphur not over 0.05 percent.	236
(8)	Cut structural and plate scrap, 2 feet and under. Same as cut structural and plate scrap 3 feet and under, except for length.	237
(9)	Cut structural and plate scrap, 1 foot and under. Same as cut structural and plate scrap, 3 feet and under, except for length.	238
(10)	Siliconibusheling. Clean silicon-bearing steel scrap, not exceeding 12 inches in any dimensions, including new factory busheling (for example, sheet clippings, stampings), having a silicon content of 0.5 percent to 5.0 percent.	239
(11)	Silicon clippings. Clean steel scrap, including new factory busheling (for example sheet clippings, stampings, etc.), may not include old auto body and fender stock. Free of metal coated, limed, vitreous enameled, and electrical sheet containing minimum one percent silicon.	240
(12)	Foundry steel, 2 feet and under. Steel scrap 1/8 inch and over in thickness, not over 2 feet in length or 18 inches in width. Individual pieces free from attachments. May not include nonferrous metals, cast or malleable iron, cable, vitreous enameled, or metal coated material.	242
(13)	Foundry steel, 1 foot and under. Same specifications as 2 foot material, except for length.	243
(14)	Springs and crankshafts. Clean automotive springs and crankshafts, either new or used.	244

Electric Furnace Casting and Foundery Grades, continued

		ISIS Code Number
(15)	Alloy free turnings. Clean shoveling steel turnings free from lumps, tangled or matted material, iron borings, or excessive oil containing not more than 0.05 percent phosphorus or sulphur, and free of alloys.	245
(16)	Silicon bundles. Silicon sheet steel scrap, clippings or skeleton scrap, compressed or hand bundled, to charging box size, and weighing not less than 75 pounds per cubic foot, having a silicon content of 0.05 percent to 5.0 percent.	250
(17)	Heavy turnings. Short, heavy steel turnings, containing not over 0.05 percent phosphorus or sulphur and free of alloys. May include rail chips. May not include machine shop or other light turnings and must weigh not less than 75 pounds per cubic foot in the original state of production.	251

Cast Iron Grades

(1)	Cupola cast. Clean cast iron scrap such as columns, pipes, plates, and castings of a miscellaneous nature, including automobile blocks and cast iron parts of agricultural and other machinery. Free from stove plate, burnt iron, brake shoes or foreign material. Cupola size, not over 24 inches x30 inches, and no piece over 150 pounds in weight.	252
(2)	Charging box cast. Clean cast iron scrap in sizes not over 60 inches in length or 30 inches in width, suitable for charging into an open hearth furnace without further preparation. Free from burnt iron, brake shoes, or stove plate.	253
(3)	Heavy breakable cast. Cast iron scrap over charging box size or weighing more than 500 pounds. May include cylinders and driving wheel centers. May include steel which does not exceed 10 percent of the casting by weight.	254
(4)	Burnt iron. Burnt cast iron scrap, such as stove parts, grate bars, and miscellaneous burnt iron. May include sash weights or window weights.	256
(5)	Mixed cast. May include all grades of cast iron except burnt iron. Dimensions not over 24 inches x30 inches and no piece over 150 pounds in weight.	257
(6)	Stove plate. Clean cast iron stove; free from malleable and steel parts, window weights, plow points, or burnt cast iron.	258
(7)	Clean auto cast. Clean auto blocks; free of all steel parts except camshafts, valves, valve springs, and studs. Free of nonferrous and nonmetallic parts.	259
(8)	Unstripped motor blocks. Automobile or truck motors from which steel and nonferrous fittings may or may not have been removed. Free from drive shifts and all parts of frames.	260
(9)	Drop broken machinery cast. Clean heavy cast iron machinery scrap that has been broken under a drop. All pieces must be of cupola size, not over 24 inches x30 inches, and no piece over 150 pounds in weight.	261
(10)	Clean auto cast, broken, not degreased. Clean auto blocks, free of all steel parts except camshafts, valves, valve springs and studs. Free of nonferrous and nonmetallic parts, and must be broken to cupola size, 150 pounds or less.	262

Cast Iron Grades, continued

		ISIS Code Number
(11)	Clean auto cast, degreased. Free of all steel parts except camshafts, valves, valve springs, and studs. Free of nonferrous and nonmetallic parts, and must be broken into cupola size, 150 pounds or less.	263
(12)	Malleable. Malleable parts of automobiles, railroad cars, locomotives, or miscellaneous malleable iron castings. Free from cast iron and steel parts and other foreign material.	264

[1] Excerpted from Institute of Scrap Iron & Steel (ISIS) Handbook (1975).

	Railroad Ferrous Scrap*	AAR Number
(1)	Axles, Steel. Solid car and/or locomotive friction-bearing, 8 inches in diameter and under (free of axles (2) with key-way between wheel seats, no axles of shorter lengths than distance between wheel seats to be included).	(2)
(2)	Axles, Steel. Solid car and/or locomotive friction-bearing, over 8 inches in diameter (free of axles with (2A) key-way between wheel seats, no axles of shorter lengths than distance between wheel seats to be included).	(2A)
(3)	Axles, Steel. Roller bearing 8 inches in diameter and under (no axles of shorter lengths than distance (3) between wheel seats to be included).	(3)
(4)	Axles, Steel. Roller bearing over 8 inches in diameter (no axles of shorter lengths than distance between wheel seats to be included).	(3A)
(5)	Spikes, Track Bolts and Nuts, and Lock Washers, may include Rail Anchors.	(4)
(6)	Tie Plates. Steel.	(5)
(7)	Rail Joints, Angle and/or Splice Bars. Steel.	(6)
(8)	Bolsters and/or Truck Sides, Frames: Uncut. Cast steel.	(9)
(9)	Cast-Steel, No. 2. Steel castings, over 18 inches wide and/or over 5 feet long.	(11)
(10)	Cast Steel, No.1. Steel castings, 18 inches and under, not over 5 feet long, including cut truck side frames and bolsters.	(11A)
(11)	Cast Iron, No.1. Cast iron scrap, such as columns, pipes, plates, and/or castings of miscellaneous nature, but free from stove plates, brake shoes, and burnt scrap. Must be cupola size, not over 24 inches x30 inches in dimension and no piece to weigh over 150 pounds. Must be free from foreign material.	(12)
(12)	Cast Iron, No. 2. Pieces weighing over 150 pounds, but not more than 500 pounds. Free from burnt cast.	(13)
(13)	Cast Iron, No. 3. Pieces weighing over 500 pounds; includes cylinders, driving wheel centers and/or all other castings. (Free from hammer blocks or bases.)	(14)
(14)	Cast Iron, No.4. Burnt cast iron scrap, such as grate bars, stove parts and/or miscellaneous burnt scrap.	(15)
(15)	Cast Iron Brake Shoes. Brake shoes of all types except composition-filled shoes.	(16)
(16)	Couplers and/or Knuckles. Railroad car and/or locomotive steel couplers, knuckles and/or locks stripped clean of all other attachments.	(17)

Railroad Ferrous Scrap, continued

		ISIS Code Number
(17)	Frogs and/or Switches, uncut Steel frogs and switches that have not been cut apart, exclusive of manganese.	(18)
(18)	Railbound Manganese Frogs and Switch Points with manganese inserts that have not been cut apart.	(18A)
(19)	Malleable. Malleable parts of automobiles, railroad cars, locomotive and/or miscellaneous malleable castings.	(23)
(20)	Melting Steel, Railroad No.1. Clean wrought iron or steel scrap, 1/4 inch and over in thickness, not over 18 inches in width, and not over 5 feet in length. May include pipe ends and material 1/8 inch to 1/4 inch in thickness, not over 15 inches x15 inches. Individual pieces cut so as to lie reasonably flat in charging box.	(24)
(21)	Rail, Steel No. 1. Standard section tee rails, original weight 50 pounds per yard or heavier, 10 feet long and over. Suitable for rerolling into bars and shapes. Free from bent and twisted rails, frog, switch, and guard rails, or rails with split heads and broken flanges. Continuous welded rail may be included provided no weld is over 9 inches from the end of the piece of rail.	(27)
(22)	Rail, Steel No. 2 Cropped Rail Ends. Standard section, original weight of 50 pounds per yard and over, 18 inches long and under.	(28A)
(23)	Rail, Steel No.2 Cropped Rail Ends. Standard section, original weight of 50 pounds per yard and over, 2 feet long and under.	(28B)
(24)	Rail, Steel No. 2 Cropped Rail Ends. Standard section, original weight of 50 pounds per yard and over, 3 feet long and under.	(28C)
(25)	Rail, Steel No.3. Standard section steel, girder, and/or guard rails, to be free from frog and switch rails not cut apart, and contain no manganese, cast, welds, or attachments of any kind except angle bars. Free from concrete, dirt, and foreign material of any kind.	(29)
(26)	Sheet Scrap, No.1. Under 1/16 inch thick, may include hoops, band iron and/or steel, scoops and/or shovels (free of wood). Must be free from burnt or metal coated material, cushion, or other similar springs.	(30)
(27)	Sheet Scrap, No.2. Galvanized or tinned material and/or gas retorts, and/or any other iron or steel material not otherwise classified.	(31)
(28)	Steel, Tool. (Specify kind in offering.)	(32)
(29)	Steel, Manganese. All kinds of manganese, rail, guard rails, frogs and/or switch points, cut or uncut.	(33)

Railroad Ferrous Scrap, continued

		ISIS Code Number
(30)	Steel, Spring. Coil and/or elliptical, minimum thickness 1/4 inch may be assembled or cut apart.	(34)
(31)	Steel, Spring. Coil only.	(34A)
(32)	Structural, Wrought Iron and/or Steel Uncut. All steel or steel mixed with iron from bridges, structures and/or equipment that has not been cut apart, may include uncut bolsters, brake beams, steel trucks, underframes, channel bars, steel bridge plates, frog and/or crossing plates and/or other steel of similar character.	(35)
(33)	Tires. All locomotive, not cut to specified lengths.	(36)
(34)	Turnings, No.1. Heavy turnings from wrought iron and/or steel railroad axles or heavy forgings and/ or rail chips, to weigh not less than 75 pounds per cubic foot. Free from dirt or other foreign material of any kind. Alloy steel scrap may be excluded from these specifications by mutual agreement between buyer and seller.	(38)
(35)	Turnings, Drillings and/or Borings, No.2. Cast, wrought, steel and/or malleable iron borings, turnings and/or drillings mixed with other metals.	(38A)
(36)	Wheels, No. 1. Cast iron car wheels.	(40)
(37)	Wheels, No.3. Solid cast steel, forged, pressed and/or rolled steel car and/or locomotive wheels, not over 42 inch. (Specify kind in offering.)	(42)
(38)	Destroyed Steel Cars. Bodies of steel cars cut apart sufficiently to load. (Specify kind)	(45)
(39)	Destroyed steel car Sides and Box Car Roofs. Cut to a maximum length of and a maximum width of suitable for use in super presses and shears without additional preparation.	(45A)

*Specifications of Association of American Railroads Promulgated by its Purchases and Materials Management Division (Revised 1973).

C5.A2. ATTACHMENT 2 TO CHAPTER 5

INDUSTRY SPECIFICATIONS FOR NONFERROUS SCRAP [1]

		NARI Item	NARI Code Word
(1)	No.1 Copper Wire-Shall consist of No. 1 bare, uncoated, unalloyed copper wire, not smaller than No.16 B&S wire gauge. Green copper wire and hydraulically compacted material to be subject to agreement between buyer and seller.	2	Barley.
(2)	No 1 Copper Wire-Shall consist of clean, untinned, uncoated, unalloyed copper wire and cable, not smaller than No. 16 B & S wire gauge, free of burnt wire which is brittle. Hydraulically briquetted copper subject to agreement.	31	Berry.
(3)	No.2 Copper Wire-Shall consist of miscellaneous, unalloyed copper wire having a nominal 96% copper content (minimum 94%) as determined by electrolytic assay. Should be free of the following: Excessively leaded, tinned, soldered copper wire; brass and bronze wire; excessive oil content, iron, and nonmetallics; copper wire from burning, containing insulation; hair wire; burnt wire which is brittle; and should be reasonably free of ash. Hydraulically briquetted copper wire subject to agreement.	4	Brich.
(4)	No. 1 Heavy Copper-Shall consist of clean, unalloyed, uncoated copper clippings, punchings, bus bars, commutator segments, and wire not less than 1/16 of an inch thick, free of burnt wire which is brittle; but may include clean copper tubing. Hydraulically briquetted copper subject to agreement.	5	Candy.
(5)	No.2 Copper-Shall consist of miscellaneous, unalloyed, copper scrap having a nominal 96% copper content (minimum 94%) as determined by a electrolytic assay. Should be free of the following: Excessively leaded, tinned, soldered copper scrap; brasses and bronzes; excessive oil content, iron and nonmetallics; copper tubing with other than copper connections or with sediment; copper wire from burning, containing insulation; hair wire; burnt wire which is brittle; and should be reasonably free of ash. Hydraulically briquetted copper subject to agreement.	6	Cliff.
(6)	Light Copper-Shall consist of miscellaneous, unalloyed copper scrap having a nominal 92% copper content (minimum 88%) as determined by electrolytic assay and shall consist of sheet copper, gutters, downspouts, kettles, boilers, and smiliar scrap. Should be free of the following: Burnt hair wire; copper clad; plating racks; grindings; copper wire from burning, containing insulation; radiators; fire extinguishers; refrigerator units; electro type shells; screening; excessively leaded, tinned, soldered scrap; brasses and bronzes; excessive oil, iron and nonmetallics; and should be reasonably free of ash. Hydraulically briquetted copper subject to agreement. Any items excluded in this grade are also excluded in the higher grades above.	10	Dream.
(7)	Refinery Brass-Shall contain a minimum of 61.3% copper and maximum 5% iron and to consist of brass and bronze solids and turnings, and alloyed and contaminated copper scrap. Shall be free of insulated wire, grindings, electrotype shells and nonmetallics. Hydraulically briquetted material subject to agreement.	11	Drink.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(8)	Copper-Bearing Scrap-Shall consist of miscellaneous copper-containing skimmings, grindings, ashes, irony brass and copper, residues and slags. Free of insulated wires; copper chlorides; unprepared tangled material; large motors; pyrophoric material; asbestos brake linings; furnace bottoms; high lead materials; graphite crucibles; and noxious and excessive materials. Fine powered material by agreement. Hydraulically briquetted material subject to agreement.	12	Drove.
(9)	Insulated Copper Wire Scrap-Shall consist of copper wire scrap with various types of insulation. To be sold on a sample or recovery basis, subject to agreement between buyer and seller.	13	Druid.
(10)	Composition or Red Brass-Shall consist of red brass scrap, valves, machinery bearings and other machinery parts, including miscellaneous castings made of copper, tin, zinc, and/or lead. Should be free of semi-red brass castings (78% to 81% copper); railroad car boxes and other similar high-lead alloys; cocks and faucets; closed water meters; gates; pot pieces; ingots and burned brass; aluminum, silicon, and manganese bronzes; iron and nonmetallics. No piece to measure more than 12 inches over any one part or weigh over 100 pounds.	14	Ebony.
(11)	Red Brass Composition Turnings-Shall consist of turnings from red brass composition material and should be sold subject to sample or analysis.	15	Enerv.
(12)	Genuine Babbitt-Lined Brass Bushings-Shall consist of red brass bushings and bearings from automobiles and other machinery, shall contain not less than 12% high tin base babbitt, and shall be free of iron-backed bearings.	16	Eider.
(13)	High Grade-Low Lead Bronze Solids-It is recommended these materials be sold by analysis.	17	Eland.
(14)	Bronze Paper Mill Wire Cloth-Shall consist of clean genuine Fourdrinier wire cloth and screen having a minimum copper content of 87%, minimum tin content of 3% and a maximum lead content of 1%, free of stainless steel and Monel metal stranding.	18	Elbow.
(15)	High Lead Bronze Solids and Borings-It is recommended that these materials be sold on sample or analysis.	19	Elias.
(16)	Machinery or Hard Brass Solids-Shall have a copper content of not less than 75%, a tin content of not less than 6%, and a lead content of not less than 6%-nor more than 11%, and total impurities, exclusive of zinc, antimony, and nickel of not more than 0.75%; the antimony content not to exceed 0.5%. Shall be free of lined and unlined standard red car boxes.	20	Engel.
(7)	Machinery or Hard Brass Borings-Shall have a copper content of not less than 5%, a tin content of not less than 6%, and a lead content of not less than 6%-nor more than 11%, and the total impurities, exclusive of zinc, antimony, and nickel of not more than 0.75%; the antimony content not to exceed 0.5%.	21	Erin.
(18)	Unlined Standard Red Car Boxes (Clean Journals)-Shall consist of standard unlined and/ or sweated railroad boxes and unlined and/or sweated car journal bearings, free of yellow boxes and iron-backed boxes.	22	Fence.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(19)	Line Standard Red Car Boxes (Lined Journals)Shall consist of standard babbitt-lined railroad boxes and/or babbitt-lined car journal bearings, free of yellow boxes and iron backed boxes.	23	Ferry.
(20)	Cocks and Faucets--Shall consist of mixed clean red and yellow brass, including chrome nickel-plated, free of gas cocks, beer faucets, and aluminum and zinc base die cast material, and to contain a minimum of 35% semi-red.	24	Grape.
(21)	Mixed Brass Screens-To consist of clean mixed-copper, brass and bronze screens, and to be free of excessively dirty and painted material.	25	Greet.
(22)	Yellow Brass Scrap-Shall consist of brass castings, rolled brass, rod brass, tubing and miscellaneous yellow brasses, including plated brass. Must be free of manganese bronze, aluminum bronze, unsweated radiators or radiator parts, iron, excessively dirty and corroded materials.	26	Honey.
(23)	Yellow Brass Castings-Shall consist of yellow brass castings in crucible shape, no piece to measure more than 12 inches over any one part; and shall be free of brass forgings, silicon bronze, aluminum bronze and manganese bronze, and not to contain more than 15% nickel-plated material.	27	Ivory.
(24)	Old Rolled Brass-Shall consist of old pieces of yellow sheet brass and yellow light tubing brass, free from solder, tinned and nickel-plated material, iron, paint and corrosion, rod brass and condenser tubes.	28	Knife.
(25)	New Brass Clippings-Shall consist of the cuttings of new unleaded yellow brass sheet or plating to be clean and free from foreign substances and not to contain more than 10% of clean brass punchings under 1/4 inch. To be free of Muntz metal and naval brass.	29	Label.
(26)	Brass Shell Cases Without Primers-Shall consist of clean fired 70/30 brass shell cases free of primers and any other foreign material.	30	Lace.
(27)	Brass Shell Cases With Primers-Shall consist of clean fired 70/30 brass shell cases containing the brass primers and which contain no other foreign material.	31	Lady.
(28)	Brass Small Arms and Rifle Shells, Clean Fired-Shall consist of clean fired 70/30 brass shells free of bullets, iron and any other foreign material.	32	Lake.
(29)	Brass Small Arms and Rifle Shells, Clean Muffled (Popped)-Shall consist of clean muffled (popped) 70/30 brass shells free of bullets, iron and any other foreign material.	33	Lamb.
(30)	Yellow Brass Primer-Shall consist of clean yellow brass primers, burnt or unburnt. Free of iron, excessive dirt, corrosion and any other foreign material.	34	Lark.
(31)	Mixed New Nickel Silver Clippings-Shall consist of one or more nickel silver alloys and the range of nickel content to be specified, free of chrome or any other plating material. Leaded nickel silver clippings should be packed and sold separately. Not to contain more than 10% of clean punchings under 1/4 inch.	35	Maize.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(32)	New Nickel Silver Clippings and Solids-Shall consist of new, clean nickel silver clippings, plate, rod and forgings, and other rolled shapes, free of chrome or any other plating material. Must be sold on nickel content specifications such as 10%-12%-15%-18%-20%. Leaded nickel silver clippings should be packed and sold separately. Adescription as to its physical characteristics should be made in offering all nickel silver material.	36	Major.
(33)	New Segregated Nickel Silver Clippings-Shall consist of one specified nickel silver alloy. Not to contain more than 10% of clean punchings under 1/4 inch.	37	Malar.
(34)	Old Nickel Silver-Shall consist of old nickel silver sheet, pipe, rod, tubes, wire, screen, soldered or unsoldered. Must not be trimmed seams alone and it is also to be free of foreign substances, iron rimmed material or other metals.	38	Malic.
(35)	Brass Pipe-Shall consist of brass pipes free of plated and soldered materials or pipes with cast brass connections. To be sound, clean pipes free of sediment and condenser tubes.	39	Melon.
(36)	Nickel Silver Castings-To be packed and sold separately.	40	Naggy.
(37)	Nickel Silver Turnings-To be sold by sample or analysis.	41	Niece.
(38)	Yellow Brass Rod Turnings-Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin and Muntz metal turnings; not to contain over 3% free iron, oil or other moisture; to be free of grindings and babbitts; to contain not more than 0.3% tin and not more than 0.15% alloyed iron.	42	Night.
(39)	New Yellow Brass Rod Ends-Shall consist of new, clean rod ends from free turning brass rods or forging rods, not to contain more than 0.3% tin and no more than 0.15% alloyed iron. To be free of Muntz metal and naval brass or any other alloys. To be in pieces not larger than 12 inches and free of foreign matter.	43	Noble.
(40)	Yellow Brass Turnings-Shall consist of yellow brass turnings, free of aluminum, manganese and composition turnings; not to contain over 3% of free iron, oil or other moisture; to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample or analysis.	44	Nomad.
(41)	Mixed Unsweated Auto Radiators-Shall consist of mixed automobile radiators, to be free of aluminum radiators, and iron finned radiators. All radiators to be subject to deduction of actual iron. The tonnage specification should cover the gross weight of the radiators, unless otherwise specified.	45	Ocean.
(42)	Admiralty Brass Condenser Tubes-Shall consist of clean sound Admiralty condenser tubing which may be plated or unplated, free of nickel alloy, aluminum alloy, and corroded material.	46	Pales.
(43)	Aluminum Brass Condenser Tubes-Shall consist of clean sound condenser tubing which may be plated or unplated, free of nickel alloy and corroded material.	47	Pallu.
(44)	Muntz Metal Tubes-Shall consist of clean sound Muntz metal tubing which may be plated or unplated, free of nickel alloy, aluminum alloy, and corroded material.	48	Palms.
(45)	Plated Rolled Brass-Shall consist of plated brass sheet, pipe, tubing, and reflectors, free of soldered, tinned, corroded, and aluminum painted material, Muntz metal and Admiralty tubing, and material with cast brass connections.	49	Pants.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(46)	Manganese Bronze Solids-Shall have a copper content of not less than 55%, a lead content of not more than 1%, and shall be free of aluminum bronze and silicon bronze.	50	Parch.
(47)	Scrap Lead-Soft-Shall consist of clean soft scrap lead, free of all foreign materials such as drosses, battery lead, lead covered cable, hard lead, collapsible tubes, foil, type metals, zinc, iron and brass fittings, dirty chemical lead. Free of radioactive materials.	51	Racks.
(48)	Mixed Hard/Soft Scrap Lead-Shall consist of clean lead solids, free of foreign materials, such as drosses, battery lead, lead covered cable, collapsible tubes, type metals, zinc, iron and brass fittings, dirty chemical lead. Free of radioactive materials.	52	Radio.
(49)	Battery Plates-If cells (plates, separators, and lugs) or battery plates, must be reasonably free of rubber. May be bought and sold by assay or as agreed between buyer and seller.	53	Rails.
(50)	Drained Whole Batteries-Batteries to be free of liquid and extraneous material content. Aircraft (aluminum or steel cased) and other special batteries subject to special agreement.	54	Rains.
(51)	Battery Lugs-Shall be free from battery plates, rubber and foreign material. A minimum of 97% metallic content is required.	55	Rakes.
(52)	Pewter-Shall consist of tableware and soda fountain boxes but should contain a minimum of 84% tin. Siphon tops to be accounted for separately. Material must be free of brass, zinc, and other foreign metals.	56	Ranks.
(53)	Block Tin-Block tin must assay minimum of 98% tin, and be free of liquids, solder, and brass connections, pewter, pumps, pot pieces, dirt.	57	Ranch.
(54)	High Tin Base Babbitt-Shall contain a minimum of 78% tin and be free of brassy or zincy metals.	58	Raves.
(55)	Lead Covered Copper Cable-Free of armored covered cable, and foreign material.	59	Relay.
(56)	Lead Weights-May consist of lead balances with or without iron, as may be specifed. Free of foreign matters.	61	Ropes.
(57)	Mixed Common Babbitt-Shall consist of lead base bearings metal containing not less than 8% tin, free from Allens metal, ornamental, antimonial and type metal. Must be free from all zincy and excessive copper in the alloy.	62	Roses.
(58)	Old Zinc Die Cast Scrap-Shall consist of miscellaneous old zinc base die castings, with or without iron and other foreign attachments. Must be free of borings, turnings, dross pieces, chunks, melted pieces and skimmings. All unmeltables, dirt, foreign attachments, and volatile substances (such as rubber, cork, plastic, grease, etc.) are deductible. Material containing in excess of 30% iron will not constitute good delivery.	63	Saves.
(59)	New Zinc Die Cast Scrap-Shall consist of new or unused, clean zinc base die castings. Castings to be unplated, unpainted, and free from corrosion.	64	Scabs.
(60)	New Plated Zinc Die Cast Scrap-Shall consist of new or unused clean, plated zinc base die castings, free from corrosion.	65	Scope.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(61)	Zinc Die Cast Automotive Grilles-Shall consist of clean, old or used zinc base die cast automotive grilles, free from soldered material. All foreign attachments and extraneous materials are deductible.	66	Scoot.
(62)	Old Scrap Zinc-Shall consist of clean dry scrap zinc, such as sheets, jar lids, clean, unalloyed castings and anti-corrosion plates. Borings and turnings are not acceptable. Material must not be excessively corroded or oxidized. All foreign attachments and extraneous materials are deductible.	67	Score.
(63)	New Zinc Clippings-Shall consist of any new pure zinc sheets or stamping free from corrosion. To contain no foreign material or attachments. Printers zinc, such as engravers zinc, lithograph sheets and addressograph plates subject to special arrangements. Printers zinc to be free of routings.	68	Screen.
(64)	New Pure Aluminum Clippings-Shall consist of new, clean, unalloyed sheet, clippings and/or aluminum sheet cuttings, free from oil and grease, foil and any other foreign substances and from punchings less than 1/2 inch in size.	76	Table.
(65)	Mixed Low Copper Aluminum Clippings and Solids-Shall consist of new, clean, uncoated and unpainted low copper aluminum scrap of two or more alloys and be free of 7000 series, foil, hair wire, wire screen, dirt, and other foreign substances. Grease and oil not to total more than 1%. Also free from punchings less than 1/2 inch in size. New can stock subject to arrangement between buyer and seller.	77	Taboo.
(66)	Mixed Old Alloy Sheet Aluminum-Shall consist of clean, old alloy sheet aluminum of two or more alloys and be free of 7000 series, foil, venetian blinds, castings, hair wire, screen wire, food or beverage containers, pie plates, dirt, and other foreign substances. Oil and grease not to total more than 1%. Up to 10% painted sidings and awnings permitted.	78	Tabor.
(67)	Scrap Sheet and Sheet Utensil Aluminum-Shall consist of clean, unpainted old 2S or 3S aluminum sheet and sheet utensils, free from hub caps, radiator shells, airplane sheet, foil, food or beverage containers, pie plates, oil cans and bottle caps, dirt, and other foreign substances. Oil and grease not to total more than 1%.	79	Taint.
(68)	New Aluminum Can Stock-Shall consist of new low copper aluminum can stock and clippings, clean, lithographed or not lithographed, and coated with clear lacquer but free of lids with sealers, iron, dirt and other foreign contamination. Oil not to exceed 1%.	80	Take.
(69)	Old Can Stock-Shall consist of clean, old aluminum cans, decorated or clear, free of iron, dirt, liquid and/or other foreign contamination.	81	Talc.
(70)	Painted Siding-Shall consist of clean, low copper aluminum siding scrap, painted one or two sides, free of iron, dirt, corrosion, fiber backing or other types of foreign contamination.	84	Tale.
(71)	Coated Scrap-Shall consist of awnings, venetian blinds, vinyl, plastic, etc. Shall be subject to special arrangements between buyers and sellers.	85	Talent.
(72)	Aluminum Copper Radiators-Shall consist of clean aluminum and copper radiators, and/or aluminum fins or copper tubing, free of brass tubing, iron and other foreign contamination.	86	Talk.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(73)	New Pure Aluminum Wire and Cable-Shall consist of new, clean, unalloyed aluminum wire or cable free from hair wire, wire screen, iron, insulation and any other foreign substance.	88	Talon.
(74)	New Mixed Aluminum Wire and Cable-Shall consist of new, clean unalloyed aluminum wire or cable which may contain up to 100% 6000 series wire and cable free from hair wire, wire screen, iron, insulation and any other foreign substance.	89	Tann.
(75)	Old Pure Aluminum Wire and Cable-Shall consists of old, unalloyed aluminum wire or cable containing not over 1% free oxide or dirt and free from hair wire, wire screen, iron, insulation and any other foreign substance.	90	Taste.
(76)	Old Mixed Aluminum Wire and Cable-Shall consist of old, unalloyed aluminum wire and cable which may contain up to 10% 6000 series wire and cable with not over 1% free oxide or dirt and free from hair wire, wire screen, iron, insulation and any other foreign substance.	91	Tassel.
(77)	Aluminum Pistons. (a) Clean Aluminum Pistons-Shall consist of clean aluminum pistons to be free from struts, bushings, shafts, iron rings and any other foreign materials. Oil and grease not to exceed 2%. (b) Aluminum Pistons with Struts-Shall consist of clean whole aluminum pistons with struts to be free from bushings, shafts, iron rings and any other foreign materials. Oil and grease not to exceed 2%. (c) Irony Aluminum Pistons-Should be sold on recovery basis, or by special arrangements with purchaser.	92	Tarry.
(78)	Segregated Aluminum Borings and Turnings-Shall consist of clean, uncorroded aluminum borings and turnings of one specified alloy only and subject to deductions for fines in excess of 3% through a 20 mesh screen and dirt, free iron, oil, moisture and all other foreign materials. Material containing iron in excess of 10% and/or free magnesium or stainless steel or containing highly flammable cutting compounds will not constitute good delivery.	93	Teens.
(79)	Mixed Aluminum Borings and Turnings-Shall consist of clean, uncorroded aluminum borings and turnings of two or more alloys and subject to deductions for fines in excess of 3% through a 20 mesh screen and dirt, free iron, oil, moisture and all other foreign materials. Material containing iron in excess of 10% and/or free magnesium or stainless steel or containing highly flammable cutting compounds will not constitute good delivery. To avoid dispute, should be sold on basis of definite maximum zinc, tin and magnesium content.	94	Telic.
(80)	Mixed Aluminum Castings-Shall consist of all clean aluminum castings which may contain auto and airplane castings but no ingots, and to be free of iron, dirt, brass, babbitt and any other foreign materials. Oil and grease not to total more than 2%.	95	Tense.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(81)	Wrecked Airplane Sheet Aluminum-Should be sold on recovery basis or by special arrangements with purchaser.	96	Tepid.
(82)	New Aluminum Foil-Shall consist of clean, new, pure, uncoated, unalloyed aluminum foil, free from anodized foil, radar foil and chaff, paper, plastics, or any other foreign materials. Hydraulically briquetted material by arrangment only.	97	Terse.
(83)	Old Aluminum Foil-Shall consist of clean, old, pure, uncoated, unalloyed aluminum foil, free from anodized foil, radar foil and chaf, paper-plastics, or any other foreign materials. Hydraulically briquetted material by arrangement only.	98	Testy.
(84)	Aluminum Grindings-Should be sold on recovery basis or by special arrangements with purchaser.	99	Thigh.
(85)	Segregated New Aluminum Alloy Clippings and Solids-Shall consist of new, clean, uncoated and unpainted aluminum scrap of one specified aluminum alloy only and be free of foil, hair wire, wire screen, dirt, and other foreign substances. Oil and grease not to total more than 1%. Also free from punchings less than 1/2 inch in size. New can stock subject to arrangement between buyer and seller.	102	Tooth.
(86)	Mixed New Aluminum Alloy Clippings and Solids-Shall consist of new, clean, uncoated and unpainted aluminum scrap of two or more alloys free of 7000 series and be free of foil, hair wire, wire screen, dirt, and other foreign substances. Oil and grease not to total more than 1%. Also free from punchings less than 1/2 inch in size. New can stock subject to arrangement between buyer and seller.	103	Tough.
(87)	Segregated New Aluminum Castings, Forgings and Extrusions-Shall consist of new, clean, uncoated aluminum castings, forgings, and extrusions of one specified alloy only and be sawings, stainless steel, zinc, iron, dirt, oil, grease and foreign substances.	104	Tread.
(88)	Aluminum Auto Castings-Shall consistof all clean automobile aluminum castings of sufficient size to be readily identified and to be free from iron, dirt, brass, babbitt bushings, and any other foreign materials. Oil and grease not to total more than 2%.	105	Trump.
(89)	Insulated Aluminum Wire Scrap-Shall consist of aluminum wire scrap with various types of insulation. To be sold on a sample or recovery basis, subject to agreement between buyer and seller.	106	Twang.
(90)	Aluminum Airplane Castings-Shall consist of clean aluminum castings from airplanes and be free from iron, dirt, brass, babbitt bushings, brass bushings, and any other foreign materials. Oil and grease not to total more than 2%.	107	Twist.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(91)	Magnesium Clips-Shall consist of clean magnesium clips in crucible size, free of copper, aluminum, and zinc flashings and excessive oil and grease. To be free of all foreign attachments.	109	Wafer.
(92)	Magnesium Scrap-Shall consist of magnesium castings, magnesium engine blocks and transmission casings, bomber and car wheels, extrusions, and sheet. Material to be free from brass and copper inserts and all foreign attachments. To be free of anodes, hollow castings and explosives. Percentages of and penalties for dirt, oil, grease, and iron to be subject to agreement between buyer and seller. Excessively large pieces to be negotiated between buyer and seller.	110	Walnut.
(93)	Magnesium Engraver Plates-To be free of copper, aluminum, zinc, and electrotype plates. To be clean and free of all foreign attachments. Magnesium plates shipped loose by agreement between buyer and seller.	111	Wine.
(94)	Magnesium Dockboards-Shall consist of clean magnesium dockboard cut or broken to size agreed upon by buyer and seller. To be free of all foreign attachments.	112	Wood.
(95)	Magnesium Turnings-It is recommended that these materials be sold by special arrangement between buyer and seller.	113	World.
(96)	New Nickel Scrap-Shall consist of clean new sheet, plate, bar, tube, and any other wrought nickel scrap solids. Nickel minimum 99%. Free of castings, as well as any foreign attachments or other contamination.	114	Aroma.
(97)	Old Nickel Scrap-Shall consist of old and/or new sheet, plate, bar, tube, and any other wrought nickel scrap solids. Material to contain a minimum of 98% nickel. This grade to be free of castings, soldered, brazed, sweated, or painted material, other metallic coating, foreign attachments, and any other contamination.	116	Burly.
(98)	Miscellaneous Types of Nickel Scrap-Shall consist of miscellaneous types of nickel scrap, such as carbonized scrap, castings, strippings, peelings, baskets, and/or turnings. Particulars regarding physical description, assay, and packaging to be agreed on between buyer and seller.	117	Cache.
(99)	New Cupro-Nickel Clips and Solids-Shall consist of clean, new segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel tube, pipe, sheet, plate, or other wrought solid forms. Must be free of foreign attachments or any other contamination.	118	Dandy.
(100)	Cupro-Nickel Solids-Shall consist of old, and/or new, segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro-nickel tube, pipe, sheet, plate or other wrought solid forms. Maximum 2% sediment allowable. Any other forms of cupro nickel solids such as castings, grates, risers, spills, etc., packaged separately, may or may not be included, only upon agreement between buyer and seller. Must be free of foreign attachments and all other contamination. Other particulars concerning physical description, analysis and packaging to be agreed upon between buyer and seller.	119	Daunt.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(101)	Soldered Cupro-Nickel Solids-Shall consist of segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel solids, soldered, brazed, or sweated, must seams and edges and all other contamination.	120	Delta.
(102)	Cupro-Nickel Spinnings, Turnings, Borings-Shall consist of clean segregated (normally accepted analysis grades) either 70/30, 80/20, or 90/10 cupro nickel spinnings, turnings, or borings. Particulars concerning physical description, analysis, packaging, to be agreed upon between buyer and seller.	121	Decoy.
(104)	Old Monel Sheet and Solids-Shall consist of new and/or old clean Regular and/or R-Monel sheet, pipe, plate, rod, and all other wrought scrap solids. Must be free of foreign attachments or any other contamination. (To exclude soldered, brazed, and unclean sweated material).	123	Ideal.
(105)	K-Monel Rods and Other Solids-Shall consist of clean K-Monel rods and other solids.	124	Indian.
(106)	Soldered Monel Sheet and Solids-Shall consist of soldered and/or brazed, Regular or miscellaneous grades of Monel alloys (with basic minimum 63% nickel contained in any alloy itself), in either wrought or cast form. Must be free of trimmed seams and edges, nonmetallic filling, foreign attachments, and all other contamination. Particulars concerning physical description, assay, and packaging to be agreed upon between buyer and seller.	125	Junto.
(107)	Monel Castings-Shall consist of various types of clean Monel castings, assaying minimum 60% nickel. Must be free of foreign attachments, or any other contamination.	126	Lemon.
(108)	Monel Turnings-Shall consist of mixed Monel turnings and borings containing a minimum of 60% nickel content, on a dry basis.	127	Lemur.
(109)	200 Series Stainless Steel Scrap Solids-Shall consist of all types of clean AISI Series Stainless Steel Scrap Solids, which contain a maximum of 0.5% copper, free of foreign attachments and other contamination.	128	Pekoe.
(110)	Stainless Steel Scrap-Shall consist of clean 18-8 type stainless steel clips and solids containing a minimum 7% nickel, 16% chrome, and have a maximum of 0.5% molybdenum, 0.5% copper, 0.045% phosphorous, and 0.03% sulfur, and otherwise free of harmful contaminants. Particulars concerning physical description, grading, additional analysis, and preparation to be agreed upon between buyer and seller.	129	Sabot.
(111)	Stainless Steel Turnings-Shall consist of clean 18-8 types stainless steel turnings containing a minimum of 7% nickel and 16% chrome, and be free of nonferrous metals, nonmetallics, excessive iron, oil and other contaminants. Particulars concerning physical description, assay, packaging to be agreed upon between buyer and seller.	130	Ultra.

	Industry Specifications for Nonferrous Scrap,[1] continued	NARI Item	NARI Code Word
(112)	11-14% Chrome Stainless Scrap-Straight chrome stainless scrap shall contain 11-14% chrome, phosphorous and sulpher 0.03% maximum, and shall not contain over 0.5% nickel and otherwise be free from harmful contaminants. Material to be prepared to individual consumer's specifications.	131	Rusten.
(113)	14-18% Chrome Stainless Scrap-Straight chrome stainless scrap shall contain 14-18% chrome, phosphorous and sulphur 0.03% maximum, and shall not contain over 0.5% nickel and otherwise be free from harmful contaminants. Material to be prepared to individual consumer's specifications.	132	Rusthirty.
(114)	Edison Batteries--To be sold free of crates, copper terminal connectors, and drained free of excess liquid; to be free of type "B" batteries.	133	Vaunt.

1 Extracted from National Association of Recycling Industries (NARI) Circular NF-82.

C5.A3. ATTACHMENT 3 TO CHAPTER 5

PAPER SCRAP*

(See TableC5.T6.)

		PSIA ITEM
(1)	Mixed Paper-Consists of a mixture of various qualities of paper not limited as to type of packing or fibre content. Prohibitive materials may not exceed 2%. Total Outthrows may not exceed 10%	(1)
(2)	Super Mixed Paper--Consists of a baled clean sorted mixture of various qualities of papers containing less than 10% of groundwood stock, coated or uncoated. Prohibitive materials may not exceed 1/2 1/2 of 1%. Total Outthrows may not exceed 3%	(3)
(3)	News-Consists of baled newspapers containing less than 5% of other papers. Prohibitive materials may not exceed 1/2 of 1%. Total Outthrows may not exceed 3%.	(6)
(4)	Special News-Consists of baled sorted fresh newspapers, not sunburned, free from papers other than news, containing not more than the normal percentage of rotogravure and colored sections. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(7)
(5)	Special News De-Ink Quality-Consists of baled sorted fresh dry newspapers, not sunburned, free from magazines, white blank, pressroom over-issues, and paper other than news, containing not more than the normal percentage of rotogravure and colored sections. This packing must be free from tare. Prohibitive materials-None permitted. Total Outthrows may not exceed 1/4 of 1%.	(8)
(6)	Corrugated Containers-Consists of baled corrugated containers having liners of either test liner jute or kraft. Prohibitive materials may not exceed 1%. Total Outthrows may not exceed 5%.	(11)
(7)	Used Brown Kraft-Consists of baled brown kraft bags free of objectionable liners or contents. Prohibitive materials-None permitted. Total Outthrows may not exceed 1/2 of 1%.	(15)
(8)	Colored Tabulating Cards-Consists of printed colored or manila cards, predominantly sulphite or sulphate, which have been manufactured for use in tabulating machines. Unbleached kraft cards are not acceptable. Prohibitive materials-None permitted. Total Outthrows may not exceed 1%.	(36)
(9)	Manila Tabulating Cards-Consists of printed manila-colored cards, predominantly sulphite or sulphate, which have been manufactured for use in tabulating machines. This grade may contain manila-colored tabulating cards with tinted margins. Prohibitive materials-None permitted. Total Outthrows may not exceed 1%.	(37)
(10)	Sorted Colored Ledger-Consists of printed or unprinted sheets, shavings, and cuttings of colored or white sulphite or sulphate ledger, bond, writing, and other papers which have a similar fibre and filler content. This grade must be free of treated, coated, padded, or heavily printed stock. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(38)
(11)	Manifold Colored Ledger-Consists of sheets and side trim of new printed or unprinted colored or white sulphite or sulphate papers such as are used in the manufacturing of manifold forms, continuous forms, register forms, and similar printed papers. Those forms used once for machine data processing may be included. All stock must be untreated and uncoated. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(39)

Paper Scrap*
(See TableC5.T6.)

		PSIA ITEM
(12)	Sorted White Ledger-Consists of printed or unprinted sheets, shavings, guillotined books, quire waste, and cuttings of white sulphite or sulphate ledger, bond, writing paper, and all other papers which have a similar fibre and filler content. This grade must be free of treated, coated, padded, or heavily printed stock. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(40)
(13)	Manifold White Ledger-Consists of sheets and side trim of new printed or unprinted white sulphite or sulphate papers such as are used in the manufacturing of manifold forms, continuous forms, register forms, and similar printed papers. Those forms used once for machine data processing may be included. All stock must be untreated and uncoated. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(41)
(14)	Computer Printout-Consists of white sulphite or sulphate papers in forms manufactured for use in data processing machines. This grade may contain colored stripes and/o computer printing, and may contain not more than 5 percent of ground wood in the packing. All stock must be untreated and uncoated. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(42)
(15)	Coated Book Stock-Consists of coated bleached sulphite or sulphate papers, printed or unprinted in sheets, shavings, guillotined books or quire waste. Areasonable percentage of papers containing fine groundwood may be included. Prohibitive materials-None permitted. Total Outthrows may not exceed 2%.	(43)
(16)	Printed Bleached Sulphate Cuttings-Consists of printed bleached sulphate cuttings, free from misprint sheets, printed cartons, wax, greaseproof lamination, gilt, and inks, adhesives or coatings that are nonsoluble. Prohibitive materials may not exceed 1/2 of 1%. Total Outthrows may not exceed 2%.	(45)

* Selected entries have been excerpted from the Paper Stock Institute of America (a commodity division of NARJ)Circular PS-83.

C5.A4. ATTACHMENT 4 TO CHAPTER 5

DEFENSE REUTILIZATION & MARKETING SERVICE SCRAP CLASSIFICATION LIST

Scrap Commodity and Definition	SCL Code
FERROUS	
Heavy breakable cast.	ElQ
Iron and steel scrap, mixed with foreign attachments. Highly enameled stock, coated paint cans, tin cans, borings and turnings, highly corroded, dirty and containing excessive oil, and other inferior grades of material prohibitive to other classifications.	E1L
Miscellaneous steel scrap. Consists of inert ordnance items (practice bombs, empty projectiles, empty cartridge cases, etc.) This material may conform to a prepared grade of iron and steel scrap, however, it will be segregated as a safety factor.	E1M
Mixed cast.	E1R
Mixed iron and steel borings and turnings.	E1G
No. 1 heavy melting steel.	E1A
No. 2 heavy melting steel.	E1B
No. 1 steel bundles.	E1E
No. 2 steel bundles.	E1F
No. 1 steel busheling	E1C
No. 2 steel busheling.	E1D
Small arms parts requiring *further processing*.	E1T
Stove plate.	E10
Stripped engine blocks.	E1N
Tin can and terne plate.	E1H
Tool steel.	E1S
Unprepared heavy melting iron and steel scrap. Random lengths, widths, and thicknesses not suitable for hydraulic compression.	E1I
Unprepared light melting steel suitable for compression into No.1 bundles.	E1J
Unprepared light melting steel suitable for compression into No. 2 bundles.	E1K
Unstripped engine blocks.	E1P
Vehicles and components:	
Steel tank track, without rubber pads.	E1U
Steel tank track, with rubber pads.	E1V
Steel chain, anchors.	E1W
Vehicles, commercial/automobiles/trucks.	E2A
Vehicles, tactical, all types.	E2C
Vehicles, armored.	E2D
Vehicles, special purpose.	E2E
Tank trailers.	E2F

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
NONFERROUS	
Aluminum:	
Aluminum dross	D1G
Aluminum foil, aluminum screen	D1B
Sweated aluminum pigs and ingots.	D1F
Cast aluminum, engine blocks, transmissions, axle assemblies, and vehicular parts	D1J
Fired aluminum	D1I
Irony aluminum. Should be segregated from normal generations of wrecked aircraft aluminum because of the higher percentage of aluminum recovery. Consists of solids generated from obsolete or rejected parts, components, or accessories from which all non-aluminum parts have not been removed, and borings and turnings containing excessive oil and other foreign materials. Large quantities of borings and turnings should be segregated.	D1D
Aluminum, radiators	D1K
Aluminum solids. Pure old cable, sheet, and sheet utensils, old castings and forgings free of nonaluminum attachments.	D1C
Aluminum sheet. Plant scrap, generated by shearing, clip ting, blanking, or similar process, also defective, rejected, or otherwise discarded wrought aluminum parts castings. Must be free of foreign material.	D1A
Wrecked aircraft. Aluminum consisting of at least 50% aluminum by weight, recovered from wreckage of aircraft, salvaging of grounded and obsolete aircraft; demilitarization of combat or tactical aircraft, or salvaging of rejected airframes and components. Do not include magnesium scrap which is prohibitive to aluminum smelting and processing.	D1E
Wrecked helicopters.	D1H
Brass:	
Brass, without foreign attachments	D4E
Brass, with foreign attachments	D4F
Brass, *fired, to include blanks and all cartridge cases not specifically listed*	D2E
22 caliber expended cartridge cases	*D22*
30 caliber expended cartridge cases	*D30*
38 caliber expended cartridge cases	*D38*
45 caliber expended cartridge cases	*D45*
50 caliber expended cartridge cases	*D50*
5.56 mm expended cartridge cases	*D5M*
7.62 mm expended cartridge cases	*D7M*
9.00 mm expended cartridge cases	*D9M*
12 gauge shotgun shells, expended	D3I
Gilding metal	D4N

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
Bronze:	
Bronze, without foreign attachments	D4H
Bronze, *with foreign attachments*	*D4I*
Bullet metal Metals reclaimed from target ranges. Segregate according to basic metal material content.	D03
Copper:	
Armor cable, scrap	D4K
Copper, without foreign attachments. Miscellaneous copper free of screens, readily removable iron, lead coated copper, and Electrotype shells. Free of excessive lead, solder, paint, tar, and scale.	D4A
Mixed copper base alloys. Various grades of copper base alloys free from excessive attachments and other materials.	D2A
Copper cable, lead covered. Tinned and untinned copper wire and cable covered with a sheathing of lead, free of steel armor and other metallic coverings.	D4B
Cupro-Nickel, without foreign attachments	D4M
Cupro-Nickel, with foreign attachments	D4P
Electric motor, scrap	D4J
Insulated copper wire and cable. Tinned and untinned copper wire, cable and pieces covered with rubber, plastic, paint, enamel, fabric, and other insulation. Free of steel armor and other metallic material, asbestos covering and porcelain.	D4C
Mixed copper base alloy borings and turnings. Should be kept as free from oil and other impurities as possible.	D2C
Radiators made of copper base alloys. Vehicular, unsweated	D2D
Transformers, scrap	D4L
Copper, with foreign attachments	D4D
Mixed copper base alloys. Copper base alloys with foreign attachments not economically removable.	D2B
Electrical and Electronic residue not containing precious metals	*D4R*
Germanium	*T66*
High temperature alloys:*	
High temperature alloys not assignable to an established group	T01
High temperature alloy group 3. 1-10% Ni, 12-16% Cr, 50-67% Co	T03
High temperature alloy group 4. 55% Ni, 16% Cr	T04
High temperature alloy group 5. 2-20% Ni, 13-27% Cr, 10-60% Co	T05
High temperature alloy group 6. 25% Ni, 16% Cr	T06
High temperature alloy group 7. 1-25% Ni, 8-16% Cr	T07
High temperature alloy group 8. 70-74% Ni, 15% Cr	T00
High temperature alloy group 9. 20% Ni, 20% Cr, 40% Co	T09
High temperature alloy group 10. 60% Ni, 30% Cu	T10
High temperature alloy group 14. 12-20% Ni, 24-25% Cr	T1
High temperature alloy group 15. 2-15% Ni, 26-27% Cr, 50-60% Co	T15
High temperature alloy group 16. 75-80% Ni, 20-21 % Cr	T16

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
High temperature alloy group 18. 55% Ni, 19% Cr 13% Co	T18
High temperature alloy group 20. 37% Ni, 18% Cr, 20% Co	T20
High temperature alloy group 22. 75% Ni, 20% Cr	T22
High temperature alloy group 23. 26-30% Ni, 13-20% Cr	T23
High temperature alloy group 25. 30% Ni, 25% Cr, 30% Co	T25
High temperature alloy group 26. 36% Ni	T26
High temperature alloy group 27. 60% Ni, 15% Cr	T27
High temperature alloy group 28. 60% Ni, 25% Cr, 12% Co	T28
High temperature alloy group 29. 58% Ni, 19% Cr, 18% Co	T29
High temperature alloy group 30. 64% Ni, 8% Cr, 10% Co	T30
High temperature alloy group 32. 45% Ni, 22% Cr, 1.5% Co	T32
High temperature alloy group 33. 35% Ni, 15% Cr	T33
High temperature alloy group 55. 90% W	T55
High temperature alloy group 60. 80% Ti	T60
High temperature alloy group 62. Beryllium (Be)	T62
High temperature alloys unsegregated	*T24*
Lead:	
Aircraft batteries (lead-acid type)	D5B
Lead without foreign attachments	D5D
Lead battery plates	D5C
Other grades of lead. Common babbitt (low tin content), high speed babbitt (high tin content), and block tin (high tin content) usually found in coil pipe.	D5E
Sealed (acid-filled) batteries	D5G
Vehicle, industrial, and submarine batteries (lead-acid type)	D5A
Magnesium. Segregate clean and unclean grades.	D06
Mercury and nickel-cadmium batteries, nonprecious metal-bearing.	D12
Stainless steel scrap.*	S00
Stainless steel alloy group 1. (See SCL codes identifying high temperature and stainless steel alloy segregation groups.) 7-13% Ni, 17-19% Cr.	S0l
Stainless steel alloy group 2. 0-2% Ni, 12-16% Cr	S02
Stainless steel alloy group 12. 4% Ni, 17% Cr	S12
Stainless steel alloy group 17. 2-9% Ni, 12-20% Cr	S17
Stainless steel alloy group 21. 14% Ni, 14% Cr	S21
Stainless steel alloy group 24. 12% Ni, 25% Cr	S24
Stainless steel, magnetic.	S3B
Stainless steel, nonmagnetic.	S3A
Chrome nickel.	S3C
Nickel, miscellaneous.	S3D

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
Tantalum	*T65*
Zinc scrap	D09

* Beryllium (Be), Chromium (Cr), Cobalt (Co), Copper (Cu), Nickel (Ni), Titanium (Ti), Tungsten (W).

NONMETALLIC	
Asbestos, nonfriable.	H01
Ashes, waste (coal or wood).	H10
Chemical scrap:	
Chemical scrap, and related materials, nonprecious metal-bearing.	H02
Dehydrating agent, Grade A.	H03
Cullet	H05
Electronic tube, residue.	H11
Food:	
Bones an meat trimmings.	B02
Cooked grease. Clean and rough, including spent frying fats.	B03
Garbage, suitable for animal consumption or other use. Free of coffee grounds, onion hulls, peach pits, fish heads, tea leaves, banana peels, citrus fruit rinds, excessive grease, chicken feathers, corn husks, sweepings, paper, waxed cartons, trash, and similar items which will destroy the value of the item for hog feeding or other uses.	B01
Trap grease.	B04
Leather.	H07
Magnetic tape. Used Automatic Data Processing (ADP) computer magnetic tape no longer suited for ADP operations.	H14
Miscellaneous scrap not otherwise classifiable.	H13
Paper:	
Books and magazines.	A04
Computer paper.	A08
Ledger. White ledger stock should be segregated from colored ledger stock .	A02
Mixed paper. Free of any nonpaper substances that cannot be manufactured into paper or products by the process normally used for making paper. Obsolete forms with carbon inserts should be segregated and sold separately.	A05
Newspaper. Offer for sale as "No. 1 News," consisting of clean waste newspaper .	A03
Paper map scrap.	A07
Plain and corrugated cardboard.	A06
Tabulating cards (includes all colors with/without tinted edges). Manila-colored cards should be segregated and sold separately, including those with tinted edges.	A01
Petroleum products:	
Fuel oil, jet fuel and similar materials, used.	H16
Lubricating oil, used (motor vehicle types and similar).	H15
Oil, lubricants, grease, used.	H17

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
Synthetic base aircraft turbine engine oil, used (MIL-L-7808, 8188, and 23699).	H18
Plastic	H08
Plastic sonobuoy containers.	H04
Rope	C05
Hawser, scrap.	C1D
Rubber:	
Rubber inner tubes-aircraft.	G03
Rubber inner tubes-vehicular.	G04
Rubber scrap not otherwise classifiable.	G05
Rubber tires-aircraft.	G01
Rubber tires-vehicular.	G02
Rubbish, trash, or any other type of debris scheduled for A&D and generated from segregation of other scrap.	B00
Textiles:	
Burlap. Includes Osnaburg.	C01
Canvas.	C02
Cotton comforters, scrap.	C1B
Cotton mattresses, scrap.	C1C
Cotton rags.	C09
Nylon rags.	C07
Polyester, scrap.	C1E
Poncho, scrap.	C1F
Rags miscellaneous, not covered in other SCL codes.	C03
Rayon rags.	C06
Rubberized clothing and equipage scrap.	C1G
Silk rags.	C10
Sleeping bags, scrap.	C1H
Textile scrap, miscellaneous.	C1A
Webbing.	C04
Wool rags.	C08
Tile, concrete, bricks, clay, and crockery.	H06
Unsegregated scrap Scrap material identified by this SCL normally is intended to be segregated into other scrap commodities.	H24
Wax scrap, and related materials.	H19
Wood scrap.	F01

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
PRECIOUS METALS	
Acid-based liquids, sludge, powder, or salts derived from plating and/or deplating operations. May contain gold, silver, or platinum family metals.	P08
Ash from photographic film and paper generated from the incineration of (exposed, unexposed, processed or unprocessed) X-ray, graphic arts, motion picture, phototype setting, aerial, black and white, unprocessed color film, and other types of silver-bearing photographic film and paper.	P05
Cyanide-based liquids, sludge, powder, or salts derived from plating and/or deplating operations. May contain gold, silver, or platinum family metals.	P07
Desalter kits.	P84
Dust and filters from vacuum systems or other systems collecting fine particles; sweepings and residue other than borings, turnings, etc. May contain gold, silver or platinum family metals.	P87
Exhausted chemical recovery cartridges used for recovery of silver from hypo solution by metallic displacement. Includes sludge recovered from cartridges.	P06
Expended hypo solution, derived from the processing of photographic film and paper.	P02
Gold-bearing and gold-plated, including badges, insignia, lapel pins, miscellaneous hardware, used anodes and turnings, and gold-plated E1ectronic scrap without foreign attachments.	P8C
Gold-filled eyeglass frames.	P86
Gold-plated or washed buttons.	P85
High temp alloys containing precious metals (gold, silver, and/or platinum family metals) such as stator vanes, aircraft engine exhaust cones and aircraft panels; EXCLUDES spark plugs, thermocouples and breakers.	P13
Photographic film and paper (exposed, unexposed, processed or unprocessed), X-ray, graphic arts, motion picture, phototype setting, aerial, black and white, processed and other types of silver bearing photographic film and paper.	P04
Platinum-bearing thermocouples and magnetos.	P83
Platinum-bearing spark plugs (usually from aircraft).	P81
Platinum family (platinum, rhodium, palladium, ruthenium, iridium, and osmium) bearing and plated, such as platinum-plated electronic scrap, contact points/breakers, insignia, coding boards. EXCLUDES spark plugs, thermocouples, and entire magnetos.	P8A
Segregated, but not sorted, electrical and electronic scrap containing precious metals (gold, silver, platinum family, or a combination of metals). Scrap not segregated/classified at time of receipt or downgrade will continue to be processed under SCL H24.	P24
Precious metal-bearing electron tubes.	P8G
Silver-bearing batteries not otherwise classifiable.	P12
Silver-bearing dental amalgam excludes unused silver pellets used to make amalgam.	P8D
Silver-bearing, washed and/or plated material such as tableware, holloware, insignia, fixtures, buttons, and clean silver-plated electronic scrap.	P8B
Silver-cadmium batteries.	PB6
Silver chloride magnesium batteries (battery construction consists of silver chloride positive plates with aluminum-zinc-magnesium alloy negative plates and uses water as the electrolyte). Examples: MK35, MK61, MK67 torpedo batteries, and sonobuoy batteries.	PB1

Defense Reutilization & Marketing Service Scrap Classification List, continued Scrap Commodity and Definition	SCL Code
Silver zinc batteries which are encased in plastic, battery cell sections, and field telephone batteries in fiberboard cases.	PB4
Silver zinc batteries (complete battery) encased in metal or with metallic attachments.	PB5
Silver zinc submarine batteries consisting of large (30 lbs. and over) batteries/cells which when in use are interconnected to form one large battery. Cass may be of fiberglass or plastic construction. (Primarily research and DSRV submarine batteries.)	PB2
Sorted electrical/electronic scrap containing gold, silver, and platinum family metals which is predominately copper based and may contain insignificant amounts of other non-removable metals, e.g., iron, aluminum, etc. Includes, but not limited to, circuit boards/cards without metal frames/backs (although a small amount of metal is acceptable), plastic housed connectors, silver/silver coated wire and circuit breakers.	P8E
Sorted electrical/electronic scrap containing gold, silver, platinum family metals which is predominately coppeer based and may contain insignificant amounts of other non-removable metals, e.g., iron, aluminum, etc. Includes, but not limited to, circuit boards.cards without metal frames/backs (although a small amount of metal is acceptable), plastic housed connectors, silver/silver coated wire and circuit breakers. a. Other than copper based, or b. Copper based containing other non-removable metals. Includes, but not limited to, electronic modules/housings, aluminum or iron based waveguides, cannon plugs, circuit boards/cards with non-removable metal frames/backs and pin-wire boards.	P8F
Gold-bearing material such as powder, salts, foil, leaf, and pellets; dental castings, brazing alloys, dental lingual bars, or alloy gold-wire, and all other gold-bearing materials with 90 percent purity or better.	VGM*
Metallic silver flake derived from electrolytic processing of hypo solution; WOOG cells (small electrolytic units used with dental processors for reclamation of silver); and sludge derived from cleaning of electrolytic silver recovery units and/or holding tanks.	VSF*
Platinum family-bearing material such as dental alloys, scraps, sweepings, jewelry, laboratory ware, wire, and all other platinum family-bearing materials with 90 percent purity or better.	VPM*
Precious metals-bearing sweepings collected by vacuum cleaners.	VCS*
Silver-bearing material consisting of used anodes, drillings from anodes and grain silver, wire for welding or brazing, and all other silver-bearing material with 75 percent or better purity. Includes UNUSED silver pellets for dental amalgam.	VSM*

* Unit of measure in grams for all V-coded SCLs.

C6. CHAPTER 6

RECOVERY OF PRECIOUS METALS

C6.1. GENERAL

The DoD Precious Metals Recovery Program (PMRP) promotes economic recovery of silver, gold and platinum family metals from excess and surplus precious metal-hearing materials, and also the utilization of recovered precious metals for authorized internal purposes or as Government Furnished Material (GFM) to DoD production and repair contractors. The platinum family includes platinum, palladium, iridium, rhodium, osmium, and ruthenium. Precious metals and their alloys are highly resistant to acids and corrosions. Among these alloys are Platino, which is an alloy of 89 percent gold and 11 percent platinum, Palau, which is an alloy of gold and palladium; and Photanium, which is a rhodium-gold alloy. Platinum-rhodium alloys are used in high temperature thermocouples. Platinum-iridium alloys are used for surgical instruments (25-30 percent iridium), jewelry (5-10 percent iridium), magneto contacts (20 percent iridium), and electrical contacts in control devices (10 percent iridium). Palladium and its alloys are used principally as substitutes for platinum, since they are much cheaper than platinum and similar to, but not quite as wear resistant as platinum. Most palladium is alloyed with silver; molybdenum or other members of the platinum group. It is used for jewelry and for electrical purposes, such as potentiometer rubbing contacts and light duty impact contactors. Alloyed with gold, palladium is used in furnaces, in fuses designed to melt at a predetermined temperature inside furnaces, and in thermocouples (in conjunction with other platinum group metals and alloys). Alloys of palladium with copper, silver and gold are used in the manufacture of false teeth, where good corrsion resistance and good casting characteristics are important. Palladium alloys are also used for brazing nickel alloys and other high temperature resistant alloys which cannot be welded. The largest use for palladium is as a catalyst, either in a finely divided state or in the form of wire gauze.

C6.2. PROCESSING PRECIOUS METAL-BEARING MATERIALS

When precious metal-bearing material becomes surplus to DoD requirements, it should then be segregated into lots of similar type and form. Ultimate recovery of precious metals from these lots is dependent on the form and composition of each lot; and recovery processes may vary according to the complexity of the property contained therein. In most cases precious metal-bearing materials which have been segregated will require additional processing to detach extraneous metal (e.g., iron, aluminum,

steel) and other attached materials. To the extent practicable with precious metal-bearing materials, ferrous materials should not be commingled with nonferrous materials, metallic materials with nonmetallic materials, or liquids with solids. In addition, for safety reasons, it is mandatory that precious metal-bearing materials containing hazardous or toxic substances (e.g., cyanide) be kept separate from nonhazardous materials. (See Chapter 4 for detailed guidance regarding the identification and segregation of precious metal-bearing materials.) More detailed guidance on precious metal-bearing property requiring special processing is contained in DoD 4160.21-M, Defense Utilization and Disposal Manual, Chapter XVII.

C6.3. SALE VERSUS RECOVERY

After proper segregation and sorting of precious metal-bearing materials have been accomplished, a cost recover versus sale determination must be made. If this determination indicates that the property may have a commercial value in excess of the precious metals recovery value, it should he offered for sale. Furthermore, it is mandatory that the amount of precious metals contained therein be clearly indicated in subsequent sales descriptions of identical property.

C6.4. EXAMPLES OF PRECIOUS METAL-BEARING PROPERTY

Listed below are DoD items that may contain economically recoverable precious metals.

C6.4.1. Silver-bearing Items

C6.4.1.1. Aircraft engine hearings, bushings, ring assemblies, link pins, slip rings, counterweights,gears and numerous other small parts.

C6.4.1.2. Amalgam (silver and mercury).

C6.4.1.3. Anodes.

C6.4.1.4. Assemblies, electrical.

C6.4.1.5. Batteries (silver/copper, silver/cadmium, silver/zinc, and silver/magnesium).

C6.4.1.6. Blanking scrap punchings.

C6.4.1.7. Brazing alloys.

C6.4.1.8. Bullion.

C6.4.1.9. Chemical salts.

C6.4.1.10. Clad bimetal parts.

C6.4.1.11. Cyanide plating solutions and anode butts.

C6.4.1.12. Dental wire, tubes, strips, pellets, and silver alloy powder.

C6.4.1.13. Desalting kits.

C6.4.1.14. Drugs (silver protein, silver iodate, silver nitrate, and silver sulfate).

C6.4.1.15. Electrical/electronic relays.

C6.4.1.16. Electric motor brushes.

C6.4.1.17. Flake (from hypo solution recovery systems).

C6.4.1.18. Granulated powders.

C6.4.1.19. Jewelry sweeps.

C6.4.1.20. Mirroring solutions.

C6.4.1.21. Photographic film (photo negatives, industrial/medical X-ray, and lithographic).

C6.4.1.22. Photographic hypo solution

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C6.4.1.23. Photographic paper.

C6.4.1.24. Plated hooks or nodules.

C6.4.1.25. Plated electrical/electronic parts.

C6.4.1.26. Plated serving pieces.

C6.4.1.27. Plated utensils.

C6.4.1.28. Plated wire.

C6.4.1.29. Plating filters.

C6.4.1.30. Plating sludges/precipitates.

C6.4.1.31. Plating solutions.

C6.4.1.32. Radar antennas.

C6.4.1.33. Receiver assemblies.

C6.4.1.34. Silver-lined bearings (from diesels, locomotives, or aircraft).

C6.4.1.35. Sterling silver.

C6.4.1.36. Wave guides.

C6.4.1.37. Wiping rags.

C6.4.2. Gold-bearing Items

C6.4.2.1. Brazing alloy.

C6.4.2.2. Circuit boards and connectors.

C6.4.2.3. Copper amalgam plates.

C6.4.2.4. Dental sweeps (may also contain silver).

C6.4.2.5. Dental scrap (up to 70 percent pure gold).

C6.4.2.6. Dental wire (gold alloy).

C6.4.2.7. Electron tubes.

C6.4.2.8. Eyeglass frames.

C6.4.2.9. Gold-bearing ion-exchange resins.

C6.4.2.10. Gold chemical ware and anodes.

C6.4.2.11. Gold clad parts/connector pins.

C6.4.2.12. Gold salts/chemicals, solders.

C6.4.2.13. Gold solutions, sludges, and precipitates.

C6.4.2.14. Gold wire.

C6.4.2.15. Jewelry and optical scrap.

C6.4.2.16. Relay/contact points.

C6.4.2.17. Semiconductor plates.

C6.4.2.18. Transistors and diodes.

C6.4.2.19. Uniform buttons.

C6.4.2.20. Military decorations/insignia.

C6.4.3. Platinum/Platinum Family-bearing Items

C6.4.3.1. Aircraft magneto and relay contact points.

C6.4.3.2. Aircraft spark plugs.

C6.4.3.3. Bracket, breaker and spring assemblies for aircraft magnetos.

C6.4.3.4. Dental alloy and dentures.

C6.4.3.5. Dental wire (platinum alloy).

C6.4.3.6. Detonator fuses.

C6.4.3.7. Electronic tube grids.

C6.4.3.8. Evaporators and evaporator dishes.

C6.4.3.9. Laboratory ware, anodes, cathodes, and crucibles.

C6.4.3.10. Platinum and platinum group catalysts.

C6.4.3.11. Platinum foil.

C6.4.3.12. Safety burst discs.

C6.4.3.13. Salts and derivatives.

C6.4.3.14. Semiconductors and resistant alloys.

C6.4.3.15. Solenoid switches (platinum).

C6.4.3.16. Spark plug, resistor type, platinum electrode.

C6.4.3.17. Spinnerets and feeder dies Switch contacts.

C6.4.3.18. Telephone switchboards (paladium).

C6.4.3.19. Thermocouple wires.

C6.4.3.20. Triodes for various transmitting amplifiers.

C6.4.3.21. Voltage regulators.

C6.5. RECYCLYING OF SCRAP REMAINING AFTER PRECIOUS METAL RECOVERY

This residue should be segregated and identified as outlined in Chapter 4.

C7. CHAPTER 7

SCRAP MERCHANDISING

C7.1. GENERAL

C7.1.1. Scrap should be merchandised in such a way as to maximize net benefits to the Government. Major factors which affect those benefits include the efficiency and cost-effectiveness of scrap yard operations, the method of sale selected, the quantity/type of scrap offered for sale, how well the scrap is described when offered, how well the scrap is displayed, how well the scrap conforms to industry standards, and cost avoidance achieved through sale (in lieu of abandonment and destruction in an environmentally acceptable manner). Although there have been some constraints placed on the extent to which the Department of Defense is authorized to prepare scrap within CONUS, sales proceeds can be significantly increased by better identification and segregation of the scrap and by minimizing contaminants.

C7.1.2. Scrap should be upgraded to usable items whenever it appears that the additional proceeds generated will offset the costs involved, after considering the quality of the scrap and the type and number of buyers likely to be attracted.

C7.1.3. Personnel responsible for DoD scrap yard operations should understand that scrap dealers and brokers are indispensable to the efficient operation of the scrap recycling industry. Thus, close cooperation among dealers, brokers, and the Federal Government in a joint effort to ensure orderly flow of DoD scrap to the recycling industry is in the best interest of all concerned. DoD scrap yard personnel should also be aware of the fact that the scrap market is just as volatile and unpredictable as the stock market. Therefore, to counterbalance the effect of market swings, scrap sales should be conducted on a steady schedule at monthly or quarterly intervals.

C7.2. PRINCIPAL TYPES OF SCRAP SALES

C7.2.1. Scrap is usually offered on a one-time or a term sale. From a merchandising point of view, one-time sales will usually provide the best return. However, when impacted storage space or other circumstances make one-time sales impracticable, it may be necessary to offer ferrous and nonmetallic scrap by term sale. Nonferrous scrap normally should not be offered on term sale.

C7.2.2. If a term sale is necessary, the selling activity should consider specifying that the bid price he a percentage of the average market price as published periodically

in a designated journal. By thus gearing the bid to the published market price, the gamble is removed for both the Government and the buyer. Term sales are normally of a 1 year duration.

C7.3. OPTIMUM LOT SIZE

The optimum sales lot size is that quantity of a particular scrap material which, when sold, yields the greatest net proceeds/benefits. Each scrap yard should determine the optimum lot sizes for its own scrap generations. Optimum lot sizes will vary by scrap grade/classification and scrap location; and there may be several optimum lot sizes within a standard grade, especially within the ferrous scrap category (e.g., cast engine blocks, tank tracks, cast steam radiators). Once established, optimum lot sizes should then be updated periodically to reflect current markets. Merchandising by optimum lot size results in optimum proceeds and is well worth the effort required. Factors that should be taken into consideration when determining optimum lot sizes include:

C7.3.1. Type of Scrap Received. In view of the low return per ton received from sale of ferrous scrap, a relatively large optimum lot size (e.g., railcar, bargeload, shipload) may be required to offset transportation costs. Nonferrous and nonmetallic scrap, on the other hand, requires smaller optimum lot sizes (truckload quantities or less) because of its greater relative value.

C7.3.2. Amount of Scrap Received. Large receipts of scrap may warrant larger optimum lot sizes. Conversely, if only small quantities are received during a lengthy period, it would be unwise to have a large optimum lot size.

C7.3.3. Amount of Storage Space Available. Although a larger lot size may be optimum in terms of proceeds, a DoD scrap yard may not be able to store that quantity of scrap because of the limited space available at the scrap yard (e.g., sufficient covered storage may not be available for paper scrap). In this case, a smaller lot size would be optimum, or term sales may be necessary to keep scrap inventories manageable.

C7.3.4. Type of Loading Facilities Available. If rail waterway facilities are available consideration should be given to lotting scrap in railcar, barge-load, or even shipload quantities. When considering use of rail or waterway transportation, scrap yard managers should check for any applicable load weight limitations, possible obstructions to safe loading, availability/reliability of loading equipment, and availability of suitable scales.

C7.3.5. Extent of Contamination or Commingling. It may take larger lot sizes to stimulate an adequate number of bidders when scrap is heavily contaminated or not

properly segregated. Conversely, carefully segregated, uncontaminated and accurately identified scrap will generate greater buyer interest with smaller lot sizes.

C7.3.6. Presence/Absence of Local Markets. Optimum lot size may be dictated by the availability of a local market. For example, a large lot size may be needed to attract distant bidders because of the absence of a local market; but lot size may not be as important in areas of high local demand.

C7.3.7. Market Condition. emsp;In periods of low Overall demand for scrap, a buyer may not be willing to invest in a large quantity of scrap that he may have to sell later at a loss. In this case, smaller lot sizes may actually bring better proceeds because of the buyer's ability to quickly resell the scrap and maintain minimum inventories.

C7.3.8. Frequency of Sales. This factor, which is heavily dependent on the previous ones, can also have an independent influence on lot size. For example, if a scrap yard has one scrap sale a month, lot sizes may be smaller than if it has a sale only once a quarter.

C7.3.9. Past Sales Experience. This is a crucial factor in determining optimum lot size. DoD scrap personnel must he familiar with their past sale results to determine which size lot yielded the highest net return. However, the market is constantly changing and optimum lot size should not he based solely on past sale history. Furthermore, past sales history can be misleading because of variances between sale items, especially with respect to percentage of contamination, and accuracy of scrap identification.

C7.4. SCRAP DESCRIPTIONS

Accurate sales descriptions are absolutely essential to effective merchandising of scrap. Buyers cannot be expected to pay top prices for scrap unless it is accurately and completely described in language commonly used in the scrap recycling industry. Scrap buyers first want to know the basic material content of the item (noun name), then any important qualifications they should know about (noun name modifiers), and finally a more detailed description so they can tell if the particular item fully meets their needs. However, buyers may not even read the item description unless their interest is first stimulated by reading the catalog index.

C7.4.1. Scrap Catalog Index. Many prospective buyers first scan the catalog index rather than search through pages of detailed descriptions. Hence, they may not respond to a scrap catalog simply because they read no further than the index, only to learn later that some of the scrap described in the catalog was what they wanted. Subindexing of

items, where appropriate, immediately notifies buyers that a type of scrap in which they might be interested is being offered. For example, scrap batteries, textiles, petroleum products, high temperature alloys, brass, and stainless steels should be listed separately in the index. It is the index that is equally as important as good sales descriptions that will initially stimulate buyer interest and response, as illustrated below:

Item	Item No.		
Brass:			
Red	35	63	82
Small Arms:			
Fired:			
.38 Caliber	2	13	14
.45 Caliber	22	28	32
9.00 mm		62	74
Popped	24	55	79
Yellow	36	54	96
Steel:			
Heavy, Unprepared	77	88	104
Light & Heavy, Unprepared	66	68	102

C7.4.2. Basic Noun Name

C7.4.2.1. The basic noun name or phrase should establish an immediate concept in the potential buyer's mind of the type of scrap being offered, and it should be the first word(s) used in the sales description. To illustrate:

Preferred:	STEEL, HEAVY, UNPREPARED SCRAP:
	TABULATING CARDS, MANILA, SCRAP:
Not Preferred:	UNPREPARED HEAVY MELTING STEEL SCRAP:
	SCRAP TABULATING CARDS, MANILA:

C7.4.2.2. When the material content of a scrap item cannot be categorized as a single basic material because it is a composed of several basic materials, first identify the product from which it was derived. Then, list the principal materials it contains. To illustrate:

RADIATORS, SCRAP	Containing copper coils, aluminum fins, and with other nonferrous and ferrous attachments.
RAGS, MIXED SCRAP	Includes 50% cotton ground targets and clothing, 30% wool and 20% nylon. Some with metallic and nonmetallic attachments consisting of snaps, buttons, etc., not to exceed 2% of total weight.

C7.4.2.3. When a variety of scrap which is closely related is being offered as a single sale item, describe the scrap as miscellaneous. Then identify some of the items in the description. To illustrate: Miscellaneous Electrical and Electronic, Scrap: Including cabinets, chassis and radio equipment. However, never describe scrap offerings as miscellaneous if they can be better segregated or more accurately described.

C7.4.3. Noun Name Modifier(s)

C7.4.3.1. Modifier(s), indicating a state or degree of differentiation, should follow the basic noun name or phrase in the scrap description. To illustrate:

COPPER, HEAVY, SCRAP:
COPPER, MIXED HEAVY, SCRAP:
STEEL, HEAVY, PREPARED, SCRAP:
STEEL, LIGHT, UNPREPARED, SCRAP:
CAST IRON, BURNT, SCRAP:
CAST IRON, CUPOLA GAST, SCRAP:
TABULATING CARDS, MANILA, SCRAP:
TABULATING CARDS, MIXED COLORS, SCRAP:
ALUMINUM, SHEETS AND CLIPPINGS, SCRAP:
ALUMINUM, TURNINGS AND BORINGS, SCRAP:
BRASS, VALVES, SCRAP:

C7.4.3.2. Some words, which appear to be modifiers, are actually part of the noun name and should therefore not be separated from it. To illustrate:

Preferred:	IRONY ALUMINUM SCRAP RED BRASS, SCRAP LEAD BATTERIES, SCRAP
Not Preferred:	ALUMINUM, IRONY, SCRAP BRASS, RED, SCRAP BATTERIES, LEAD, SCRAP OR LEAD, BATTERIES, SCRAP

C7.4.3.3. The word "SCRAP" should normally appear as the final word of the nomenclature in order to prevent any reader from misunderstanding the fact that the material being offered is scrap and not usable property.

C7.4.4. Descriptive Data

C7.4.4.1. Following the basic nomenclature, detailed descriptive data should he added, as warranted, to convey to the reader-buyer as complete a mental picture of the item as is possible. For example, including relevant details-type of property, cleanness, classification or suitability for preparation into a standard scrap grade, size, packed or loose, drained or undrained, kind and percentage of foreign attachments-will help to complete the picture for the buyer. To illustrate:

STEEL, HEAVY, UNPREPARED SCRAP: Consisting of railroad rails, 16' to 33' lengths, some suitable for rerolling into bars and shapes, others suitable for preparing into #2 Steel Rails. With foreign matter consisting of stones and dirt not to exceed 3% of total weight.

BRASS GRINDINGS AND BORINGS, SCRAP: With foreign matter, consisting of other nonferrous and ferrous metals not to exceed 5% of total weight.

NYLON, WEBBING, SCRAP: Catapult and arresting gear barrier webbing. White, soiled, with cotton stitching. Includes metallic attachments consisting of buckles and snap hooks not to exceed 10% of total weight.

C7.4.4.2. Avoid use of the word "contaminated" in describing scrap materials listed for sale. There are many ways we can tell the prospective buyer that material offered requires further preparation on his part without using the word "contaminated." Some of the more suitable and proper substitutes for this word are foreign attachments, foreign substance, foreign material, with ferrous attachments, with nonferrous attachments, etc.

C7.4.4.3. The term "foreign attachments" is not applicable to all items of scrap since many items, by their nomenclature alone, clearly indicate the existence of such attachments (e.g., insulated copper wire, automobile batteries, copper-bearing materials, irony brass, irony aluminum, miscellaneous electrical and/or electronic material, wrecked aircraft). For example, the term "foreign attachments" would not be appropriate in describing turnings and borings.

C7.4.4.4. It is also not necessary to use the term "foreign attachments" in describing scrap which, under standard industry specifications, may contain attachments in allowable amounts. For example, heavy breakable cast iron, one of the cast iron grades classified by the Institute for Scrap Iron and Steel, may include up to 10 percent steel if the steel is an integral part of the casting. In such cases, scrap yard managers should carefully comply with industry specifications with respect to what may be

included, what must be excluded, what the off-grade limits are, and the extent of cleanness required for the various grades of scrap.

C7.4.4.5. The percentage of each constituent element in an alloy should be included in the scrap description whenever such information is known to he factually correct. This is especially important in describing high temperature alloy scrap (see Chapter 5).

C7.4.4.6. Whenever scrap is loaded on pallets, or stacked in drums, engine containers, hoppers or other containers, it is important to inform buyers as to whether or not the containers are included in the sale. When they are included, the sales writer should provide either the estimated net weight of the scrap or the weight of the container.

C7.4.4.7. The quantity offered for sale should accurately reflect the amount of scrap actually available. Once a scrap lot is advertised on a one time sale, there should be no additions to or withdrawals from the lot after the beginning of the inspection period. Any scrap received thereafter should be included in the next sale. When selling scrap on term sale, care should be taken not to add excessive or unusual amounts of nonrecurring scrap to the pile that was not part of the contract. Except in areas where metric weights are generally used, ferrous scrap should be sold by the gross ton; nonferrous, by the pound; and nonmetallic, by the net ton.

C7.4.4.8. After a scrap item has been placed on a sales offering, any exceptions, corrections or withdrawals that develop prior to bid opening should he announced by issuance of an amendment prior to sale.

C7.4.5. Display. Proper display of scrap can add significantly to proceeds received. Scrap bins should be clean and properly maintained; and care should be taken to preclude any contamination of scrap stored therein. When possible, nonferrous scrap should be stored in containers or on pallets to allow for easy inspection; and each scrap lot should be listed in the sales catalog in the same location sequence in which they appear in the scrap yard. It is important that the scrap yard manager, or another knowledgeable scrap yard employee, escort prospective buyers during their inspection of scrap and that they he fully prepared to answer any questions buyers may ask. This association with buyers will also provide scrap yard personnel an opportunity to become more familiar with recycling industry terminology and with buyers' needs and concerns.

C7.5. SCRAP MARKET RESEARCH

Scrap market research is the systematic analysis of sales methods, market area, price trends, merchandising techniques, alternate usage data, and buyer interests for the purpose of improving scrap proceeds. Research on unusual, special, or hard-to-sell scrap can increase proceeds and possibly eliminate the need for costly abandonment and destruction. DoD scrap personnel actively engage in market research whenever they evaluate past sale results, seek new bidders, develop optimum lot sizes, or determine alternate uses for scrap. Market research involves a knowledge of the product, an understanding of the customer, and a knowledge of the market.

C7.5.1. Knowledge of the Product. The scrap yard supervisor must have a thorough knowledge of the type of scrap being offered if it is to be merchandised in a manner which will maximize net benefits to the Department of Defense. This knowledge can be enhanced by consulting the references listed in Appendix 2, by visiting with experienced scrap recyclers.

C7.5.2. Understanding the Customers. In CONUS, scrap dealers (or scrap processors)-not the mill, foundry, or ultimate recycler-are normally the buyers of DoD scrap. These dealers will usually base their bid price on two factors: (a) what they can resell it for, and (b) what they believe their competitors will bid. After inspecting scrap offered for sale, dealers can determine what price the item will bring and then determine the various costs they must incur (e.g, packing, transportation, and further processing) prior to resale. In a rising market, scrap dealers are usually optimists; and in a falling market, they are probably pessimists. But from the DoD point of view, they should be considered as realists who will pay (if there insufficient competition) whatever the scrap is worth at the time of a bid opening.

C7.5.3. Knowledge of the Market. The size of a scrap lot will have a distinct bearing on its marketability. For example, a truckload of high value nonferrous scrap may command national or international interest, but this amount of ferrous scrap will attract only local dealer interest. Supply and demand for various grades of scrap, which varies from month to month, will also influence optimum lot sizes. It is therefore essential that scrap yard managers keep abreast of local, national, and international market developments by reading scrap trade periodicals, and that they use this information in merchandising their scrap.

C8. CHAPTER 8

SAFETY AND HEALTH IN THE SCRAP YARD

C8.1. GENERAL

C8.1.1. Purpose:

C8.1.1.1. This safety and health guidance is for those DoD activities engaged in the assembling, sorting, processing, and distributing of scrap. The potential exists in the scrap yard for mishaps caused by faulty material handling procedures, exposures to hazardous material leaks and spills, tripping hazards, and unguarded machinery as well as injuries caused by flying fragments.

C8.1.1.2. There is also potential for serious or traumatic injury whenever powered machinery such as alligator or guillotine shears, shredders, compactors, etc., are used.

C8.1.1.3. A major health concern in the scrap yard is the torch-cutting or burning operations. Cutting or burning operations must always be carefully controlled so that workers are not overexposed to fumes. Mechanical exhaust, ventilation or respiratory protective devices may be required.

C8.1.1.4. The material in this chapter is not intended to be inclusive of all safety and health requirements. Only those items providing a high mishap exposure situation in DoD scrap yards are mentioned.

C8.1.1.5. A written Standard Operating Procedure (SOP) for emergency medical treatment must be available at each scrap yard for use in the event of an emergency.

C8.1.2. A safe operation depends largely upon employees who are properly informed and aware of potential hazards. Training needs will vary according to the complexity of the operation. Establish health education programs to ensure that all employees who work with hazardous materials are notified of the hazards to which they are exposed; relevant symptoms and appropriate emergency treatment; precautions for safe use; and appropriate PPE and control devices. Suggestions are:

C8.1.2.1. Impress upon the worker the need for constant awareness, even during automatically controlled operations.

C8.1.2.2. Ensure that all employees know when and how to use appropriate PPE. Review potential physical and chemical exposures and the parts and functions of the body that could be impaired by such exposures.

C8.1.2.3. Develop and maintain check points to be observed as a part of standard and emergency procedures.

C8.1.2.4. Post appropriate warning signs and operating procedures.

C8.1.2.5. Instruct employees in the use of fire fighting equipment.

C8.1.2.6. Instruct employees in the use of emergency showers and eye wash equipment.

C8.1.2.7. Have at least one or more persons trained in cardiopulmonary resuscitation (CPR) and first aid.

C8.1.2.8. Be sure employees authorized to use motorized equipment are thoroughly instructed in its operation and potential hazards.

C8.1.2.9. Develop a "good housekeeping" awareness to reduce accidents and to develop the employees' sense of pride in their surroundings.

C8.1.2.10. Instruct employees in safe lifting practices.

C8.2. OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENTAL CONTROL

C8.2.1. Air Contaminants

C8.2.1.1. Employees may be exposed to fumes, dusts, gases, vapors, etc., resulting from various scrap processing operations such as torch cutting, burning the covering off cables, and the breaking and salvage of batteries. When workers are exposed to excessive amounts of air contaminants, administrative or engineering controls must be considered first and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment must be provided and used by employees who must be trained in its use.

C8.2.1.2. Administrative controls limit the amount of time an individual is exposed to a health hazard during a particular operation by rotating workers. The primary method of engineering control is ventilation. After careful planning, design, and installation, the ventilation system should be checked and maintained on a regular basis.

C8.2.2. Metal Fumes and Dusts. Fumes are very small particles formed by the vaporization of metal during torch-cutting or burning operations. Metal dust is generated by grinding. Special precautions, including the use of appropriate respiratory protection, need to be taken when cutting, burning, or grinding scrap containing alloys of more toxic metals, such as lead, zinc, cadmium, or beryllium.

C8.2.2.1. Lead. Many processes involving the use of airborne lead require special precautions such as air monitoring medical surveillance. (See OSHA 1910.1025.)

C8.2.2.1.1. Lead poisoning may occur through the inhalation and/or accidental ingestion of lead fumes or dusts. The symptoms of lead poisoning include loss of appetite, metallic taste in the mouth, anemia, headache, nervous irritability, muscle and joint pains, and abdominal cramps. Chronic lead poisoning is slow and vague in its beginning and the signs and symptoms are not well defined.

C8.2.2.1.2. Galvanized steel contains lead and zinc and should he torched with care to avoid unsafe fume exposures. Terne plate is steel plate coated with an alloy of lead and tin. As a precaution, assume any paint on steel, applied as a protection against the weather or salt, contains lead.

C8.2.2.1.3. Good personal hygiene practices on the part of anyone working with lead should he stressed. Workers cutting or burning material containing lead should wash their hands thoroughly before eating. Lead contaminated gloves should he removed and hands washed before smoking. Eating must not be allowed in areas where lead cutting or burning is performed.

C8.2.2.1.4. The same hazards are present in the breakage and salvage of lead acid batteries. Care should be taken to limit worker exposure to lead fumes by exhaust ventilation methods or the use of respirators. Good personal hygiene practices should again be stressed.

C8.2.2.2. Zinc. Excessive exposure to zinc oxide, resulting from inhalation of fumes due to the Torch-cutting of zinc-containing alloys, such as galvanized steel, is the most frequent cause of an illness known as metal fume fever. This malady may also

be known as zinc chills, shakes, or "Monday morning" fever. Metal fume fever may also follow excessive exposure to a number of metal fumes including iron, cadmium, copper, lead, or nickel. The symptoms are similar to those of influenza, and include a metallic taste in the mouth, dryness of nose and throat, weakness, fatigue, muscular and joint pain, fever, chills, and nausea. These symptoms usually last less than 24 hours and a temporary immunity follows.

C8.2.2.3. Cadmium

C8.2.2.3.1. The brownish-yellow fume, cadmium oxide, produced when cutting cadmium containing metals, can be extremely hazardous health problem. This fume may, however, be masked by other metal fumes simultaneously given off. Cadmium-plated or alloy steel may look like zinc-coated steel.

C8.2.2.3.2. Excessive cadmium oxide exposure has no marked initial discomfort, however, acute symptoms occur a few hours later. These symptoms include: dry cough, irritation of throat and tightness of chest leading to difficulty in breathing, chest pains, and possible death from pulmonary edema.

C8.2.2.3. Beryllium. A single excessive exposure to beryllium fumes may result in respiratory effects ranging from a mild inflammation of the nose and throat to a severe chemical pneumonitis, possibly resulting in death.

C8.2.2.4. Other Metals. The fumes and dusts of cobalt, manganese and copper are also potentially toxic and employees' exposure must be limited to safe exposure levels by using adequate ventilation or respiratory protection.

C8.2.3. Noise

C8.2.3.1. Excessive noise can cause permanent hearing damage. Sources of noise in the scrap yard include shredders, certain cutting and shearing operations, conveyors, and heavy equipment motors or exhausts.

C8.2.3.2. For an 8-hour exposure the standard limit is 85 decibels, A-weighted (dBA). The noise standard is a sliding scale, so exposure up to 4 hours to a sound level of 90 dBA, or 2 hours at 95 dBA are allowed if exposure during the remainder of the shift is less than 85dBA. Even at these noise levels, hearing damage can be expected in some individuals. Preplacement, annual and terminal audiograms will he conducted for all employees exposed routinely to noise levels at or over 85 dBA.

C8.2.3.3. When employees are subject to sound levels exceeding the standard, feasible administrative controls (such as limiting time of exposure) or engineering

controls (such as separation or isolation of noisy operations or using vibration dampening and acoustic materials) must be implemented. Mufflers on exhausts and proper lubrication of machinery will also reduce noise levels.

C8.2.3.4. If administrative or engineering controls to reduce exposures to acceptable levels are not feasible, personal protective equipment must be provided and a continuing effective on-going hearing conservation program must be established.

C8.2.3.5. A noise survey by adequately equipped and trained personnel should be made before implementing engineering and administrative controls, and/or setting up a hearing conservation program.

C8.2.4. Other toxic and hazardous substances such as asbestos, caustics, flammables, etc., can also be found in the scrap yard. (See OSHA 1910.1000.)

C8.3. PERSONAL PROTECTIVE EQUIPMENT (PPE)

C8.3.1. General. PPE is not to be used as a substitute for feasible, administrative or engineering controls. If these control methods are not feasible, PPE is required whenever there are hazards that can do bodily harm through absorption, inhalation or physical contact. This equipment includes respiratory and protective hearing devices, clothing, and protective devices for eyes, face, head, and extremities. All PPE must be of safe design, constructed for the work to be performed and maintained in a sanitary and reliable condition.

C8.3.2. Protective Headwear. A strict "hard hat" policy must be enforced whenever hazards from falling or flying objects may occur. The wearing of hard hats in potentially hazardous areas must become a habit, and management should set a good example and also insist they be worn. The headband should he adjusted for proper head protection, comfort, and to prevent falling off.

C8.3.3. Protective Eyewear and Face Shields. Eye and face protection is required where there is a possibility of eye injury from flying particles, chips, caustic materials, etc. There is an obvious need for protection from sparks during operations such as torch-cutting, but eye injuries also occur during routine work such as operations involving hand tools, power tools, grinders, shears, and shredders. The appropriate type of eye protection (spectacle type safety glasses with side shields, goggles, and face shields) will depend on the situation encountered.

C8.3.4. Gloves. When handling materials by hand, gloves will help prevent painful cuts, which are a more serious problem if they become infected. The type of glove selected should he based on exposure.

C8.3.5. Protective Footwear. Protective footwear is required to prevent injuries resulting from punctures, and pinching or crushing caused by falling objects.

C8.3.6. Protective Clothing. Protective clothing such as flameproof aprons, leggings, and gauntlet gloves may be needed as protection from the hazards created by cutting or welding operations. Chemical resistant clothing should be selected and used when there is likely to be an exposure to hazardous chemicals (i.e., cleaning up spills, leaks).

C8.3.7. Hearing Protection: See subparagraph C8.2.3.4., above.

C8.3.8. Respiratory Protection

C8.3.8.1. National Institute of Occupational Safety and Health (NIOSH)-approved respirators will be provided when air is contaminated with excessive concentrations of harmful dusts, fumes, mists, gases, or vapors. Respirators are acceptable only when engineering or administrative controls are not feasible or while they are being implemented.

C8.3.8.2. When respirators are needed, a written respiratory protection program must be established governing the selection and use of respirators. The program must include the following requirements:

C8.3.8.2.1. Selection: Respirators must be selected which are designed and approved for protection against the specific hazards to which the worker is exposed. For example, a dust and mist respirator will not normally provide protection from paints and solvents which evolve vapors.

C8.3.8.2.2. Medical Exams: An employee must be examined by a doctor to certify that the worker is physically able to wear a respirator.

C8.3.8.2.2.1. The doctor should be fully informed of the job and its exertion. Tests such as lung function x-rays, or others may be necessary in certain cases to make an accurate assessment.

C8.3.8.2.2.2. Heart or lung problems may limit or preclude the wearing of respirators.

C8.3.8.2.3. Training: Employees must be trained in the uses of respirators, their limitations, proper fitting and maintenance.

C8.3.8.2.3.1. Everyone's face is different. Several varieties of selected types should be available to ensure a proper fit.

C8.3.8.2.3.2. Instructions must include how to do fit tests for an air purifying (canister-cartridge) respirator. Plug up the filters in the respirator and breathe in gently. If the mask does not hold a vacuum, then it is not a good fit. Beards, sideburns, and/or glasses may interfere with a good face seal.

C8.3.8.2.3.3. Respirators and their parts have a limited life. Cartridges must be replaced after a specified lifetime or when vapor odors are noted in the mask. Dust masks, filters and cartridges must be replaced when breathing becomes difficult.

C8.3.8.2.3.4. Inspect the respirator after using. Defects such as weakened straps, cracked or broken seals and deteriorated rubber parts must be replaced. A respirator which is not pliable will not seal properly.

C8.3.8.2.4. Cleaning: Respirators should be cleaned at the end of each day's use. Washing with a mild detergent solution and rinsing thoroughly with clean water is a simple measure to control dirt and disease.

C8.3.8.2.5. Storage: Respirators must be stored in a clean and sanitary location. Each employee should store his respirator in a particular location avoid mixing them. Sharing respirators is not a recommended practice.

C8.4. MATERIAL HANDLING EQUIPMENT

C8.4.1. Forklifts. Forklifts are classified into categories for the purpose of determining what type of forklift may be used in certain locations. The type of hazard in a location determines whether diesel, electric, gasoline, or LP-gas powered forklifts may be used.

C8.4.1.1. High-lift rider trucks must be fitted with an overhead guard to protect the operator from falling objects.

C8.4.1.2. Methods must he developed and used to effectively train operators in the safe operation of forklifts, and only trained and authorized operators may operate the forklift.

C8.4.1.3. When a forklift is left unattended (operator 25 feet or more away or lift not in view), the forks must be fully lowered, the control lever placed in neutral, the power shut off, and the brakes set. The wheels must be blocked if parked on an incline.

C8.4.1.4. Forklifts must be inspected daily by the operator for any condition adversely affecting the safety of the vehicle before being placed in service. If the forklift is used for more than one shift, it must be inspected before each shift.

C8.4.1.5. If the load being carried obstructs forward view, the operator is required to travel with the load trailing.

C8.4.1.6. When unloading or loading from trucks, trailers, or rail cars with forklifts, provision must be made for securing the truck, trailer, or rail car by setting the brakes and wheel chocks under the rear wheels. Portable dock boards must be secured in position with devices which will prevent their slipping during loading and unloading.

C8.4.2. Cranes. Although the guidance provided in this subparagraph pertains specifically to cranes, these requirements should be applied to all hoisting equipment.

C8.4.2.1. All new cranes constructed and installed or in use on or after August 31, 1971, must meet the design specification of the American National Standard Institute Standards. Cranes constructed prior to that date should be modified to conform to these design specifications, unless it can be shown crane cannot feasibly or economically be altered and the crane substantially complies with the requirements.

C8.4.2.2. Occupational Safety and Health Administration (OSHA) requirements also are applicable and are only highlighted below:

C8.4.2.2.1. Only qualified operators shall be permitted to operate a crane.

C8.4.2.2.2. Hoods, ropes, chains, brakes, and all functional operating mechanisms must be inspected daily for indications of damage or excessive wear.

C8.4.2.2.3. Written and signed inspection reports must be made monthly on critical items such as brakes, hooks, and ropes and must be readily available.

C8.4.2.2.4. The hoist chain or rope must be free of kinks or twists and must not be wrapped around the load.

C8.4.2.2.5. Loads must not be carried over the heads of people.

C8.4.2.2.6. The operator must not leave his position at the controls while the load is suspended.

C8.4.2.2.7. All cranes using a lifting magnet must have a switch in the magnet circuit with provision for locking the switch in the open position.

C8.4.2.2.8. When the hook is in the extreme low position at least two complete wraps of cable must remain on the drum and the ends must be securely attached to the drum.

C8.4.2.2.9. A substantial and durable load rating chart with clearly legible letters and figures must be securely fixed in a location easily visible by the operator while seated at the controls.

C8.4.2.2.10. Hand signal charts will be posted so as to be clearly visible by the operator.

C8.4.2.2.11. The minimum clearance of 10 feet must be maintained between any part of a crane and any energized wires or any wire when the status is unknown.

C8.4.3. Slings

C8.4.3.1. Each day, before use, slings and all fastenings and attachments must be inspected.

C8.4.3.2. The following safe practices must be used whenever using a sling:

C8.4.3.2.1. Damaged or defective slings must not be used.

C8.4.3.2.2. Slings must not be shortened with knots, bolts, or other makeshift devices.

C8.4.3.2.3. Sling legs must not he kinked.

C8.4.3.2.4. Slings must be padded or protected from the sharp edges of their loads.

C8.5. MACHINERY AND MACHINE GUARDING

C8.5.1. General

C8.5.1.1. One or more methods of machine guarding must be provided to protect the operator and other employees in the machine area from hazards, such as point of operation, in-running nip points, rotating parts, flying chips, and sparks. All such hazards located seven feet or less above the ground, floor, or working platform, must be guarded. Machines designed for fixed locations must be securely anchored to prevent "walking" or tipping.

C8.5.1.2. The most common methods of guarding against a hazard or hazardous machine operation are:

C8.5.1.2.1. Enclose the operation (preferred).

C8.5.1.2.2. Interlocking devices.

C8.5.1.2.3. Moving barriers.

C8.5.1.2.4. Removal devices.

C8.5.1.2.5. Remote control.

C8.5.1.2.6. Two hand tripping devices.

C8.5.1.2.7. Electronic safety devices.

C8.5.2. Alligator Shears and Notchers (Metal Scrap)

C8.5.2.1. A guard must be provided at the point of operation to prevent the employee from inserting hands into the area of operation. Employees should be trained by supervisors or other experienced personnel in the techniques of handling small parts in holding tools and in the manipulation of the shear's controls.

C8.5.2.2. Blades must be kept sharp to facilitate the cutting process rather than having the material being broken or shredded.

C8.5.2.3. The operator and others in the vicinity must wear protective goggles or face shields as a protection against flying fragments.

C8.5.2.4. On foot operated hydraulic shears, the pedal should have a protective guard to prevent unplanned operation caused by falling objects or someone accidentally stepping on it.

C8.5.2.5. A hold-down device at the in-feed side should be provided, capable of restraining the material from being forced upward during the shearing stroke.

C8.5.3. Guillotine Shears (Metal Scrap)

C8.5.3.1. The operator should have all auxiliary personnel clearly within his view at all times.

C8.5.3.2. All affected workers in the shearing area must be protected by curtains or deflectors capable of intercepting ejected parts, or the area should be roped or fenced off or otherwise restricted to worker entry.

C8.5.3.3. Hand-fed or conveyor-fed guillotine shears should have an electrical interlock-type gate that will exclude personnel from the point of operation by preventing the shear's operation until the gate is closed.

C8.5.4. Shredders (Metal and Paper Scrap)

C8.5.4.1. When shredders that may throw random pieces of material back toward the inlet opening are used, flexible shields should be installed as a protection for loaders or passersby. Alternatively the hazardous area could be roped or fenced off to restrict entry.

C8.5.4.2. Warning signs should be posted.

C8.5.4.3. Where conveyors are used to load the shredder, there should be "STOP" controls within easy and quick access to employees working on the line.

C8.5.5. Compactors and Balers (Metal and Paper Scrap). All balers or scrap compressing equipment must be guarded so that the ram or compacting device cannot be activated until workers are out of the danger area. On paper balers, where the scrap is put into a pit prior to compression, an interlocking device which will allow operation of the ram only after the loading gates are closed and in place should be used. On large metal compactors the operator must have a clear unobstructed view of the loading, compacting, and unloading areas to be sure all personnel are safely clear of the operating area.

C8.5.6. Grinders

C8.5.6.1. Safety wheel guards must cover the spindle end, nut and flange projections. The exposed area of the grinding wheel and sides for the safety guards should not exceed more than one-fourth of the entire wheel.

C8.5.6.2. Work or tool rests must be of strong construction and designed to be adjustable to compensate for wheel wear. Work rests must be closely adjusted to the wheel, with a maximum clearance of one-eighth inch.

C8.5.6.3. Tongue guards must be constructed so that the tongue guard can be adjusted to the constantly decreasing diameter of the wheel. The distance between the tongue guard and the wheel must never be more than one-fourth inch.

C8.5.6.4. Goggles or a face shield must be worn by the operator.

C8.6. TORCH CUTTING

C8.6.1. General

C8.6.1.1. Management must establish areas for torch cutting based on the fire potential of the work area. Preferably, cutting should be done in an area with no surrounding combustible materials. Suitable fire extinguishing equipment must be maintained for instant use if combustibles are in the area.

C8.6.1.2. Torch cutters must be suitably trained in the safe operation of their equipment.

C8.6.1.3. No cutting or other hot work shall be performed on used drums, barrels, tanks, or other containers until they have been cleaned so thoroughly as to make absolutely flammable materials present or other materials which, when subjected to heat, might produce flammable or toxic vapors.

C8.6.1.4. Goggles or suitable eye protection must be worn during cutting operations.

C8.6.1.5. Workers adjacent to the cutting areas must be protected by wearing appropriate goggles.

C8.6.1.6. Employees exposed to hazards created by cutting must be protected by PPE such as flame-proof gauntlet, aprons, and fire resistant leggings or high boots.

C8.6.2. Ventilation and Respirators

C8.6.2.1. There are specific requirements concerning ventilation and respirators when cutting is performed on the following materials:

C8.6.2.1.1. Stainless steel, lead, zinc, or cadmium.

C8.6.2.1.2. Metals coated with lead or mercury-containing materials such as paint.

C8.6.2.1.3. Fluxes or other materials containing fluorides.

Table C8.T1. Requirements For Ventilation and Respirators

Material	Confined Spaces	Indoors	Outdoors
Lead	Aor B	A	C
Zinc	Aor B	A	
Cadmium*	Aor B	Aor B	C
Beryllium*	Aor B	Aor B	Aand B
Mercury*	Aor B	Aor B	C
Fluorine*	Aand B		
Stainless Steels	A	A	A

* Unless atmospheric tests under the most adverse conditions have established that worker's exposures are within acceptable concentrations defined by 29 Code of Federal Regulations (CFR) 1910.100.

A= Mechanical local exhaust ventilation by means of either hoods or booths with sufficient airflow to maintain a velocity, away from the worker, of at least 100 linear feet per minute.

B = NIOSH approved supplied air respirator.

C = NIOSH approved respiratory protective equipment.

C8.6.2.2. Mechanical ventilation must be provided when cutting is done on metals not covered in the table above when:

C8.6.2.2.1. There is less than 10,000 cubic feet volume per cutter.

C8.6.2.2.2. The ceiling is less than 16 feet high.

C8.6.2.2.3. Work must be performed in confined spaces.

C8.6.2.3. Such mechanical ventilation must be at the minimum rate of 2,000 cubic feet per minute per cutter, unless hoods or booths are provided with sufficient airflow to maintain a velocity (away from the worker) of at least 100 linear feet per minute. Alternatively, NIOSH-approved supplied air respirators must he used.

C8.7. DEMILITARIZATION

Munitions List Items will be demilitarized in accordance with policy and procedures set forth in DoD 4160.21-M-1, Defense Demilitarization Manual.

C8.8. ENVIRONMENTAL CONSIDERATIONS

For DPDS activities, guidance on personal property requiring special environmental considerations is contained in internal Service/Agency publications.

C9. CHAPTER 9

RESERVED

C8.1. RESERVED

AP1. APPENDIX 1

PRIMARY SCRAP RECYCLING ORGANIZATIONS

AP1.1.1.	AISI	American Iron and Steel Institute
AP1.1.2.	AMS	Aeronautical Material Specifications
AP1.1.3.	APAR	Association of Petroleum Re-Refiners
AP1.1.4.	ARA	Aluminum Recycling Association
AP1.1.5.	ASA	American Standards Association
AP1.1.6.	ASME	American Society of Mechanical Engineers
AP1.1.7.	ASTM	American Society for Testing and Materials
AP1.1.8.	BIR	Bureau International de la Recuperation (Reclamation)
AP1.1.9.	COMEX	Commodity Exchange (American)
AP1.1.10.	ISIS	Institute of Scrap Iron and Steel
AP1.1.11.	LME	London Metal Exchange
AP1.1.12.	NARI	National Association of Recycling Industries
AP1.1.13.	PSIA	Paper Stock Institute of America
AP1.1.14.	SAE	Society of Automotive Engineers
AP1.1.15.	TAPPI	Technical Association of the Pulp and Paper Industry

AP2. APPENDIX 2

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RECYCLING

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Recycling Iron and Steel Scrap Saves Energy

"Scrap Processors and Resource Recovery ... The Need for Expanded Markets" (reprint from the NCRR Bulletin)

Mines Above Ground

The following publications are available from National Association of Recycling Industries, Inc., 330 Madison Ave., New York, NY 10017:

RecyclingAluminum

Recycling Copper and Brass

Recycling in Your Community

Recycling Resources: Priorities for the 1980's

Recycling Provides Resources for America's Future

Recycling Responds: An Industry at Work for America's Future

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